

# BHARATIYA JYOTISH SASTRA

SANKAR BALAKRISHNA DIKSHIT

## PART I

### History of Astronomy during the Vedic and Vedanga periods



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English Translation  
of  
**BHARATIYA JYOTISH SASTRA**  
(History of Indian Astronomy)

by

**Sankar Balakrishna Dikshit**

[Translated by Prof. R. V. Vaidya, M. A. B. T.]

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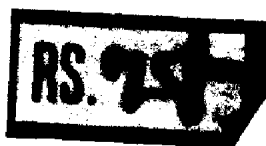
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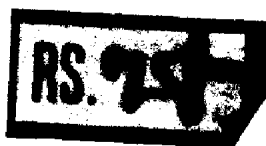
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been shrouded in allegorical language and concealed in stories and anecdotes, the full significance of which it is difficult to surmise. One such comprehensive study, perhaps the only one of its kind, has been undertaken by Shri Sankar Balakrishna Dikshit in his treatise in Marathi "Bharatiya Jyotish Sastracha Prachin Ani Arvachin Itihas " in the year 1896 and this is perhaps the only book recording the history of the Indian Astronomy from the ancient to the modern times. Late Dr. M. N. Saha, F.R.S., while working as Chairman of the Calendar Reform Committee recommended that an English translation of this excellent treatise "Bharatiya Jyotish Sastra, a history of Indian Astronomy—ancient and modern " should be published by the Government in order to facilitate Indologists, both Indian and foreign, to carry on research on Indian Astronomy. The work of the translation of this treatise from Marathi to English was gladly undertaken by Prof. R. V. Vaidya, M.A., B.T., a Marathi scholar and Superintendent of Shree Jiwaji Observatory, Ujjain and who was also a member of the Calendar Reform Committee. This translation was examined and touched up here and there by Late Prof. P. C. Sen Gupta, M.A., a renowned Professor of Hindu Astronomy of the Calcutta University. With the transfer of the entire work of the Calendar Reform Committee to the India Meteorological Department, it decided to publish this work. The final editing of the book has been done under the supervision of Shri N. C. Lahiri, M.A., Officer-in-charge of the Nautical Almanac Unit at the Meteorological Office, Alipore, Calcutta.

The book is rather voluminous and it would take considerable time to publish the whole book in one volume. Hence it has been decided to publish the book in three parts. The present volume which is Part I traces the history of Indian Astronomy in the Vedic and Vedanga period from the ancient times upto 1000 B.C. Attempts are being made to bring out the other two parts comprising of the Siddhantic period and the Modern period as early as possible.

*India Meteorological Department,  
Lodi Road, New Delhi.  
18th April, 1968.*

L. S. MATHUR,  
*Director General of Observatories.*

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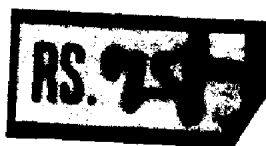
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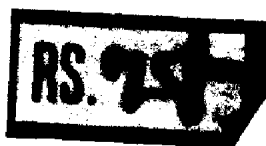
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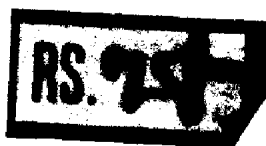
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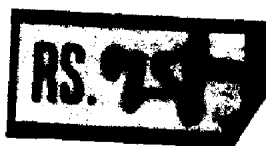
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## TRANSLITERATION

The scheme of transliteration of Sanskrit alphabets into Roman script adopted in this publication is the same as generally followed. The corresponding scripts are given below :

|         |         |        |         |        |         |
|---------|---------|--------|---------|--------|---------|
| अ<br>a  | आ<br>ā  | इ<br>i | ई<br>ī  | उ<br>u | ऊ<br>ū  |
| ऋ<br>ṛ  | लृ<br>ṛ | ए<br>e | ऐ<br>ai | ओ<br>o | औ<br>ou |
| क<br>k  | ख<br>kh | ग<br>g | घ<br>gh | ङ<br>ṅ |         |
| च<br>c  | छ<br>ch | ज<br>j | झ<br>jh | ञ<br>ñ |         |
| ट<br>ṭ  | ठ<br>ṭh | ड<br>ḍ | ढ<br>ḍh | ण<br>ṇ |         |
| त<br>t  | थ<br>th | द<br>d | ध<br>dh | न<br>n |         |
| प<br>p  | फ<br>ph | ब<br>b | भ<br>bh | म<br>m |         |
| य<br>y  | र<br>r  | ल<br>l | व<br>v  | श<br>ś |         |
| ष्<br>ṣ | स<br>s  | ह<br>h | म्<br>m | ः<br>: |         |
|         |         |        |         | ह<br>h |         |

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“The sun enters *Agni* in the evening. Hence *Agni* is visible at night even from a distance.”

In this verse the sun is said to be entering *Agni* at night. The primitive man's attention must have been drawn to the moon just as much as to the sun or even more. Unlike the sun, the moon does not rise regularly at night. Sometimes when it rises at sunset the moon appears full in size, and then, a days pass on the moon rises later and later every day and gradually grows smaller in size. It also rapidly changes its position among the stars.

It slowly approaches the sun and a day comes when it becomes completely invisible and then after a day or two, the moon makes its appearance in the west after sunset on the other side of the sun; but at that time, it appears only in the form of a crescent, as if it were newly born. It is well known that on this day even now we find that people joyfully offer her the frills of their garments and pray to her for new garments and long life, chanting all the while the following *Mantra* which is found in all the four Vedas.

नवो नवो भवति जायमानोऽह्नां केतुर्ब्रह्मसामेश्वरं ॥

भागं देवेभ्यो विदधात्यायन्प्रचंद्रमास्तिरते दीर्घमायुः ॥

ऋ. सं. १०. ८५. १६.

The moon gradually increases in size as days pass and again becomes full some day. Many descriptions of the moon's waxing and waning are found in ancient and modern works. And what is more, the digits of the moon, the dark spots on her face, her soft and serene appearance and her refreshing light, have provided an outstanding theme for poetic imagination in all countries at all times.

The moon becomes full after 29 or 30 days, and it becomes full again and again after the same number of days. The primitive man must have adopted the day (i.e. a day and night together) as the natural unit of time, after observing that the period between two successive sunrises is almost the same. Similarly, after observing the rule about the full moon stated above, he must have adopted the period between the consecutive full moons as the second but a longer unit of measuring time. This period seems to have received the same term as that given to the moon in many languages. In the Vedic literature, the moon is named as *māsa*. As an example the following lines may be seen :—

Rk Samhitā and Atharva Samhitā—

सूर्यामासा मिथ उच्चरातः । ऋ. सं. १०. ६८. १०. अथ. सं. २०. १६. १०.

Rk Samhitā—

सूर्यामासा विचरन्ता दिवि । ऋ. सं. १०. ६२. १२.

That the name *māsa* originally given to the moon was later applied to the above mentioned period is well known.

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(i) *Siddhānta*, (ii) *Tantra* and (iii) *Karaṇa*. The *Karaṇa* works deal with planetary calculations only. Bhāskarācārya defines *Siddhānta* as follows :—

ब्रह्मादित्रयान्तकालकलनामानप्रभेदः क्रमाच्चारश्च द्युसदा द्विधाच गणितं प्रश्नास्तथा सोत्तराः ।  
भूविषयग्रहसंस्थितेश्च कथनं यन्त्रादि यत्रोच्यते सिद्धांतः स उदाहृतोऽत्र गणितस्कंधप्रबंधे बुधैः ॥६॥

सिद्धांतशिरोमणि, मध्यमाधिकार.

“The wise people describe the *Ganita Skandha* (i.e. the branch of mathematical astronomy) as that work, which gives in detail all the units of time from *Truṭi* (moment) to *Pralaya* (Universal deluge) and deals with the motions of planets, and which treats of mathematics in the form of questions and answers. It is mainly divided into two parts. It also describes the position of the earth, the stars, the planets and also the instruments for observation.”—*Siddhānta Śiromaṇi, Madhyamādhikāra*.

*Siddhānta* or *Tantra* generally consists of two parts, one mainly deals with the calculation of planets' places and the other chiefly describes the structure of the universe ; and this includes the knowledge of the celestial sphere, the construction of instruments, the units of the measurement of time and other allied subjects. These two parts are not and cannot remain separate, Almost all *Siddhāntas* show as an intermingling of the two. Some people define *Siddhānta*, *Tantra* and *Karaṇa* in the following way :—

In the *Siddhānta* work the beginning of the *Kalpa* is taken to be the epoch ; in the *Tantra* the epoch is the beginning of a *Mahāyuga*, and in the *Karaṇa* any Śaka year can be the epoch, and the calculations of planets' places are made on the basis of the respective epochs. As a matter of fact there is no difference between them in regard to the computation of planetary positions excepting that each adopts a different epoch. The part of the work devoted to planetary calculations in all the three varieties contains a number of chapters called *Adhyāya* or *Adhikāra*. In general, the chapters are as follows :—

1. The mean places of planets.
2. The true places of planets.
3. The three problems (time, place and direction).
4. The lunar eclipse.
5. The solar eclipse.
6. The shadow cast by the gnomon.
7. The rising and setting of planets.
8. The elevation of the moon's cusp.
9. The conjunction of the planets.
10. The conjunction of planets and stars.
11. The luni-solar parallel.

It is not the fact that all works contain the same number of chapters as above. Although there are variations in the number and order of chapters, yet all of them have been included in the above list of eleven chapters.

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motion, and they revolve round the earth. This description is found in all *Siddhānta* works and *Tantras*, but not in *Karāṇa*-works. It is also found in the *Pañca-Siddhāntikā*. In no man-made or written works on astronomy do we find any expression of views more ancient than those found in the *Pancā-Siddhāntikā* and hence the lines presenting the above ideas are quoted below :

पंचमहाभूतमयस्तारागणपञ्जरे महीगोलः ॥

खेयस्कांतांतःस्थो लोह इवावस्थितो वृत्तः ॥१॥

मेरोः समोपरि वियत्यक्षो व्योम्नि स्थितो घ्रुवोऽधोन्यः ॥

तत्र निबद्धो मरुता प्रवहेण भ्राम्यते भगणः ॥२॥

चंद्रादूर्ध्वं बुधसितरविकुजजीवार्कजास्ततो भानि ॥३॥

अध्याय १३ त्रैलोक्यसंस्थान.

“The round ball of the earth, composed of the five elements, abides in space in the midst of the starry sphere, like a piece of iron suspended between magnets. 1. Straight above *merū* in space one pole is seen; the other pole is seen below, placed in space. Fastened to the poles the sphere of the stars is driven round by the *pravaha* wind. 5. Above the moon there are Mercury, Venus, the Sun, Mars, Jupiter, and Saturn, and then the stars. 39.”  
—*Trailokya Saṁsthāna*, Chapter 13.

The starry belt, along with planets, appears to make one complete revolution round the earth in about one day. But it was only Āryabhaṭa I, who held the modern view that this diurnal motion is not real but apparent and is caused by the diurnal rotation of the earth; others held that the diurnal motion of the starry belt was real and almost all the authors of *Siddhāntas* have blamed Āryabhaṭa for holding a divergent view.

The planets appear to move from west to east with respect to the stars and in the science of astronomy this kind of planetary motions have principally to be dealt with. The *Sūrya-Siddhānta* has explained this eastward motion of planets as follows :—

पश्चाद् ब्रजंतोऽतिजवानक्षत्रैः सततं ग्रहाः ॥ जीयमानास्तु लंबन्ते तुल्यमेव स्वमार्गगाः ॥२५॥

मध्यमाधिकार.

“The planets being overtaken by the stars moving with greater speed in their westward motion, fall behind equal distances in their orbits (and hence they get an eastward motion)” —*Madhyamādhikāra*-25.

In substance, this means that the diurnal motions of planets being less than those of the stars, the planets lag behind and hence they appear to move eastward with respect to the stars.

Āryabhaṭa I had already taken it for granted that the diurnal motion of the stars was not real and hence it was not necessary for him to make any assumption like the above to explain the eastward motion of the planets. He had already assumed a real eastward motion for them.

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## THE AYANA CALANA

(The shifting of the solstitial points)

The period that elapses between two successive 'conjunctions' of the sun with a particular star is termed *Nākṣatra saura varṣa* or 'Sidereal Solar year'. The two points of intersection of the ecliptic and the equator are called *Sampāta* or *Krāntipāta* (i.e. equinoxes). The equinox from which the sun enters into the northern side of the equator and which marks the spring season is known as *Meṣa* or *Vasanta Sampāta*, that is, the vernal equinox.

Let us suppose that at some time there is a star coinciding with this equinoctial point and that when the sun comes to that point the year commences. The equinox has got a motion, and it recedes back at the rate of 50" per year. On account of this, the stellar zodiac appears to be moving to the east by an equal arc. The time taken by the sun to return to the same equinox is termed as *Sāmpātik Saura* (i.e., tropical) year. This is also called the *ārtava* (seasonal), and the *sāyana* year. When the sun would return to the same equinox it would, as it were, find the above-mentioned fixed star still 50" ahead, and it would require about 50 *palas* (twenty minutes) more to arrive at the star. Hence, the sidereal year is found to be longer than the tropical year by about 50 *palas*. The seasons depend upon the tropical year. If there is a particular season when the sun comes to an equinox, the same season would recur every time the sun returns to the same equinox again; on the other hand, it is evident that the same season would not be found recurring at every conjunction of the sun with a star. If one point of the orbit shifts its position every other point also does so. As the equinoctial point recedes, the solstitial points also fall back; hence if the winter solstice is found to occur when the sun is near a particular star, the future solstitial transits will be found occurring gradually further westward from that star. The motion of the solstitial points which is the same as that of the equinoctial points was first detected from the westward position of the sun with respect to stars at the time of successive solstices. Hence, this motion is termed as *Ayana Calana* or the shifting of the solstitial points.

## THE YUGA SYSTEM OF MEASURING TIME

The measure (length) of the *Kaliyuga* is 4,32,000 years. Those of *Dvāpara*, *Tretā* and *Kṛta* are respectively twice, thrice and four times of this. These four *yugas* constitute the *Mahāyuga* and its measure is ten times that of the *Kaliyuga* and is equal to 43,20,000 years. One thousand such *Mahāyugas* make one *Kalpa*, which is known as *Brahmā's* day. The *Kalpa* contains 14 *Manus*. So far, a period equal to 6 *Manus* and 27 *Mahāyugas* has elapsed from the commencement of the *Kalpa* up to the present i.e. the 28th *Mahāyuga*; and after passing through *Kṛta*, *Tretā* and *Dvāpara* of the current *Mahāyuga*, we are now passing through the *Kaliyuga*.



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Vedāṅgas contain two works whose whole subject matter is astronomy. These, however, deal with the mean motions and positions of planets and they are more ancient than the Siddhānta works, and that is why their study is given a place in Part One. A discussion of the limits of the periods to be assigned to the Vedic, the Vedāṅga and the Jyotiṣa-Siddhānta ages is given at the end of the part. 'Part Two' is devoted to the history of the three branches of astronomy.

The history of mathematical astronomy in this part has been presented in the order of *adhikāra* or chapters, as already mentioned, viz., the mean motions, true motions, etc. A description of the celestial sphere, the system of observation, the precession of solstices, etc., have been given in the same part. In the treatment of these subjects references to several works and authors are required to be quoted, and without their knowledge some difficulty is likely to be experienced in rightly appreciating the discussion. Hence a detailed history of astronomical works and their authors is given in the chapter on the mean motions of planets in the beginning of 'Part Two' and a discussion of the mean places and motions of planets will be found in the same chapter. The chapter on the 'true motions' is devoted to the study of true positions, motions of planets and a detailed description of the five parts of the *Pañcāṅga* (almanac) and that of different *Pañcāṅgas* current in different provinces of our country.

An adequate idea regarding the subjects and the order in which they are dealt with in the two parts may be obtained from the table of contents.

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(5) Oh *Dakṣa* ! The praiseworthy and immortal gods were born after your daughter *Aditi*.” *Rk Samhitā*, X, 72.

This means, in a general way, that some kind of Being or Existence arose first, then came into existence the directions and then the earth.

The following lines from the *Rk Samhitā* may be seen :—

ऋतंच सत्यं चाभीधात्तपसोऽध्यजायत ॥ ततो रात्र्यजायत ततः समुद्रो अर्णवः ॥१॥

समुदावर्णवादधिसंवत्सरो अजायत ॥ अहोरात्राणि बिदधद्विष्वस्य भिषंतो वशी ॥२॥

सूर्याचंद्रमसौ धाता यथापूर्वमकल्पयत् ॥ दिवं च पृथिवीं चांतरिक्षमथो स्वः ॥३॥

ऋ. सं. १०. १६०.

“(1) Truth (of thought) and truthfulness (of speech) were born of ardour penance, thence was night generated, thence also the watery ocean.

(2) From the watery ocean was the year afterwards produced, ordaining nights and days, the ruler of every moment.

(3) Dhatri in the beginning created the sun and the moon, the heaven, the earth, the firmament and the happy (sky)”.

These mantras occur in other Vedas also. The following description is given in a passage in *Taittirīya Brāhmaṇa* :—

आपो वा इदमग्रे सलिलमासीत् ॥ तेन प्रजापतिरश्राभ्यत् ॥ कथमिदं स्यादिति ॥  
सो पश्यत्युष्करपणं तिष्ठत् ॥ सोमन्यत ॥ अस्ति वै तत् ॥ यस्मिन्निदमधितिष्ठतीति ॥  
स वराहोरुषं कृत्वोपन्यमज्जत् ॥ स पृथिवीमथ आर्चत् ॥ तस्या उपहत्योदमज्जेत् ॥  
तत्पुष्करपणं प्रथयत् ॥ यदप्रथयत् ॥ तत्पृथिव्यं पृथिवित्वं ॥

अष्टक १ अध्याय १ अनुवाक ३.

The quotation describes that there was water in the beginning and that the earth was created thereafter. The *Taittirīya Samhitā* also gives similar account of the ‘creation’ in the following lines;—

आपो वा इदमग्रेसलिलमासीत् तस्मिन् प्रजापतिर्वयिर्भूत्वा चरत्स इमामपश्यतां वराहो भूत्वाऽ-  
इरतां विश्वकर्मा भूत्वा व्यमात् सा प्रथत सा पृथिव्यभवत् तत्पृथिव्यं पृथिवित्वं ॥

अष्टक ७ अध्याय १ अनुवाक ५.

According to this, water, air, and the earth, is the order of creation. The following passage from one of the Upaniṣads shows a more systematic treatment of the subject of creation.

तस्माद्वा एतस्मादात्मन आकाशः संभूतः ॥ आकाशाद्वायुः ॥ वायोरग्निः ॥ अग्नेरापः ॥  
अद्भ्य पृथिवी ॥ पृथिव्या ओषधयः ओषधीर्म्योन्नं अन्नात् पुरुषः ॥

तैत्तिरीयोपनिषद् २. १ (ब्रह्मवल्ली प्रथम खंड)

“From this Soul (*Ātman*), verily, space (*ākāśa*) arose ; from space, wind (*vāyu*) ; from wind, fire ; from fire, water ; from water, the earth ; from the earth, herbs ; from herbs, food ; from food, semen ; from semen, the person (*puruṣa*).”—*Taittirīya Upaniṣad*; 2.1 *Brahma Valli*.

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tars and) other gods dwell there. If there be one who has known this, let him come here and relate it to us.”

The object of the sage is to state that there can be no one who actually knows this.

Even then it seems that even in the Vedic age, people had a fair knowledge of the structure of the world and at least that of the configuration of the earth.

### CONFIGURATION OF THE UNIVERSE

In many places, where a reference is to be made to the world, terms like *Rodasī*, *Dyāvapṛthivī* or their equivalents, denoting a combination of the heaven and the earth have been used, which in turn shows that the world was supposed to be divided into heaven and earth as its two parts. In some places the heavens are described as being three in number. Three heavens have been indicated at several places in the Rigveda. In some places the heaven is described as the highest part of the sky or the surface of the sky. But in many other places the Universe is supposed to be divided into *Dyu* (sky), *Antarikṣa* (space) and *Pṛthivī* (earth) as the three parts ; of these, the *antarikṣa* lies in an intermediate position between the heaven and the earth and is the abode of the winds, clouds and lightning and the birds fly in it. These three parts are described in clear words in the following well-known lines of the *Puruṣa-Sukta* :—

नाभ्या आसीदंतरिक्षं शीर्ष्णो द्यौः समवर्तत ॥ पद्भ्यां भूमिः

and corresponding to their high and low positions they are believed to have been created respectively from the head, the navel, and the feet of the ‘Supreme Being’.

The following verses may further be noted :—

यः पृथिवीं व्यथमानमदंहद्यः पर्वतान् प्रकुपितां अरम्णात् ॥

यो अंतरिक्षं विममे वरीयो यो द्यामस्तभ्नात्स जनास इन्द्रः ॥

ऋ. सं. २. १२. १.

“Oh people ! He is the same god Indra who kept the shaking earth in firm position.....who adjusted the expansive space and who supported the heaven.”

त्रिर्नी अश्विना दिव्यानि भेषजा त्रिः पार्थिवानि त्रिरुदत्तमभ्यः ॥

ऋ. सं. १. ३४. ६.

“Oh Aśvins ! May you give us heavenly medicines thrice from heavens, thrice from the earth and thrice from space.”

The interpretation of the word *Adbhyaḥ* in the original text is “from the place where water-laden clouds dwell”, meaning the sky (*antarikṣa*) ; many proofs could be given in support of this interpretation and therefore it is clear that the word *antarikṣa* stands for that space in which water-laden clouds, move.

येमहीं रजसो बिदुर्विश्वेदेवासो अद्भुहः । मरुद्भिरग्र आगहि ॥

ऋ. सं. १. १६. ३.

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end of the night, when he makes this day on this side and the night on the other side. In fact he (the sun) never sets.\*\*—*Aitareya Brāhmaṇa*.

The knowledge of the earth being round in shape and being suspended in space and separated from the sky, is clearly perceived through the above mentioned allusions from the *Brāhmaṇas*. Even in *Gopatha-Brāhmaṇa* (9-10) of the Atharva Veda, we come across lines almost similar in meaning.

It seems that it was known to the people even in the Rigvedic age that the earth is round and stands supportless.

The following verse may be seen

चक्रागसः परीगहं पृथिव्या हिरण्येन मणिना शुभमानाः ॥  
न हिन्वानासस्तितिरुस्त इन्द्रं परि स्पशो अदधात्सूर्येण ॥

ऋ. सं. १. ३३. ८.

“The messengers (of periphery of the earth), who are shining with golden ornaments were unable to vanquish Indra, even when they were flying round the earth’s periphery and running with great speed. He then covered\*\* them with sun’s light.”—*Rk Samhitā*.

If the earth were flat, the sun’s rays, immediately after sunrise, would have fallen at one and the same time on the whole earth, or at least on half of its surface; but references show that the rays instead of falling at once, do so one after the other. The following verse may be seen :—

आप्रा रजांसि दिव्यानि पार्थिवा श्लोकं देवः कृणुते स्वाय धर्मणे ॥  
प्र बाहू अस्त्राक् सविता सवीमनि निवेशयन् प्रसुवन्नक्तुभिर्जगत् ॥

ऋ. सं. ४. ५३. ३.

“The brilliant sun filled with light the regions of the heaven, the space and the earth.”—*Rk Samhitā*.

The sun is rising and stretching out its arms, putting the world to sleep by turns and awakening it by turns by means of its lusture.

The mantra “the sun rises causing a gradual sleep and a gradual awakening” may be taken to mean that as the sun traverses the sky, there is night-fall in some parts of the world which are thus enveloped in darkness; and because it gradually throws light on some other parts, there is day time there. This betokens a knowledge of the roundness of the earth.†

Any such references in the Vedas as to show the earth as having been divided into *Meru-mountain*, *Jambudvīpa* and other seven islands can not perhaps be found.

\* The speaker is observing this with respect to his own place. The words “this side” refer to the side on which he stands with respect to the sun. By the words “turns himself round” he means to say that the sun, after moving in one direction till evening, changes his direction after dawn after sunset.

\*\*Commenting on this verse, Shri Shanker Pandurang Pandit the editor of *Vedarth-Yatna*, observes (*Vedarth Yatna*, Page 380, Vol. I), that “The words “*Parināham chakranasha*” clearly show that our Aryan ancestors, at the time of composing these verses doubtless knew that the earth is not flat but round spherical in shape”.

† It is clear that the *Samhitās* of all the Vedas, the *Brāhmaṇa* works and the *Upaniṣads* were not compiled in the same age. It is very difficult to assign limits to their times.  
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It will be seen that just as a prayer, 'May the manes, etc., protect us' occurs at the end of the stanza, the prayer 'May *Kṛta* and *Dvāpara* protect us' also does appear there.

कृतायादिनवदशं त्रेतायै कल्पिनं द्वापरायाधिकल्पिनमास्कंदाय सभास्थानुं ।

वा. सं. ३०. १८.

"*Ādinavadarśa* is to be offered to *Kṛta*, *Kalpi* to *Tretā*, *Adhikalpi* to *Dvāpara* and *Sabhāsthānu* to *Āskanda*"—*Vājasaneyā Samhitā*.

The commentator *Mahīdhara* renders '*Ādinavadarśa*' as one who can see fault known as *Ādinava*, and '*Kalpi*' as one who imagines. The *Taittirīya Brāhmaṇa* gives a similar but slightly different line under '*Puruṣamedha*', which runs thus :—

कृत्राय सभाविनं ॥ त्रेताया आदिनवदशं ॥ द्वापराय बहिःसदं ॥ कलये सभास्थानुं ॥

तै. ब्रा. ३. ४. १.

"A *Sabhāvi* should be procured for *Kṛta*, an *ādinavadarśa* should be offered to *Tretā*, *bahiḥsada* to *Dvāpara* and a *sabhāsthānu* to *Kali*"—*Taittirīya Brāhmaṇa*.

This stanza names the 'sacrificial persons' which should be offered to different deities. The commentary by *Mādhava* gives the meanings of these terms as follows :—

'*Sabhāvi*' is one who sits in the gambling hall; an '*ādinavadarśa*' is the observer examiner of the game (of gambling); a '*bahiḥsada*' is the one who witnesses the game without taking part in it, and a '*sabhāsthānu*' is the one who does not leave the hall even when no game is being played.

The story of *Hariścandra* occurs in the *Aitareya Brāhmaṇa*. *Hariścandra* had no son. He invoked god *Varuna* to grant him a son, promising that the son would be offered to him in sacrifice. He then got a son who was named *Rohita*. After some years when the son was being sacrificed, he ran away into a forest. After wandering in the forest for a year he returned to his village. At that time, *Indra*, taking a human form, met him and advised him to return to the forest. This happened repeatedly for four years. When *Rohita* returned again, *Indra* said to him:

कलिः शयानो भवति संजिहानस्तु द्वापरः ॥

उत्तिष्ठेत्त्रेता भवति कृतं संपद्यते चरश्चरैवेति चरैवेति ॥

ऐ. ब्रा. ३३. १५.

"One who sleeps becomes *Kali*, one who sits becomes *Dvāpara*, one who gets up becomes *Tretā*, and one who becomes a wanderer attains *Kṛta*. Therefore keep on roving, keep on roving."—*Aitareya Brāhmaṇa*.

ये वै चत्वारः स्तोमाः ॥ कृतं तत् ॥ अथ ये पंच ॥ कलिः सः ॥ तस्माच्चतुष्टोमः ॥

तै. ब्रा. १. ५. ११.

"The four *stomas* are *Kṛta* and five are *Kali* and hence the *Jyotistoma* sacrifice should be *Catuṣṭoma*"—*Taittirīya Brāhmaṇa*.

This gives a limit to the number of '*stomas*' i.e. (oblations). Some say five and some only four. Offering five would be *Kali* which is bad and offering four would be *Kṛta* which is good, and that is why the rule of offering four has been stipulated.

It can not be proved that the words *Kṛta*, etc. have been used in the definite of time; still the idea that they represent four deities is quite



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“Agni (fire) is the Saṁvatsara, Āditya (the sun) the Parivatsara, Candramā (the moon) the Idāvatsara, and Vāyu (wind) the Anuvatsara.”  
—*Taittirīya Brāhmaṇa*.

These lines mention only four names. Of these, the first three are given in the same order as in the Vājasaneyī Saṁhitā and the fourth is Anuvatsara which is different therefrom.

*Taittirīya Brāhmaṇa* says,

संवत्सराय पर्यारिणीं । परिवत्सरायाविजातां । इदावत्सरायापस्कद्वरीं ॥

इद्वत्सरायातीत्वरिं । वत्सराय विजर्जरां ॥ संवत्सराय पलिवनीं ॥

तै. ब्रा. ३. ४. १

An almost equivalent quotation from the Vājasaneyī Saṁhitā has already been given above. Both of them give the same order of year-names; there is, however, some difference in respect of the animals to be offered in the sacrifice. Even in these lines there is the repetition of the name Saṁvatsara at the end after the mention of the usual five names.

संवत्सरोसि परिवत्सरोसि ॥ इदावत्सरोसीदुवत्सरोसि ॥ इद्वत्सरोसि वत्सरोसि ॥

तै. ब्रा. ३. १०. ४.

A similar quotation from the Vājasaneyī Saṁhitā has been given above. This gives the additional name of *Iduvatsara* as the fourth year, thus making the total period consisting of six years.

Mādhavācārya, however, interpretes *Iduvatsara* as a synonym for *Anuvatsara*.

Apart from this the names like Saṁvatsara, Parivatsara and other names are found in many places in the *Taittirīya* and *Vājasaneyī Vedas*.

These passages mention a varying number of years, some of them mention five, others six, while some others only four and these too have been given in a different order every time. It cannot be definitely said whether these represent the five yearly cycle which was current in the *Vedāṅga Jyotiṣa* age. However, the reference to the 5-year cycle and the names of years comprising it in the post-Vedic works which occurs at several places must have had some support of tradition.

In short, it seems that a system, similar in many respects to the 5-year cycle system of the *Vedāṅga Jyotiṣa* must have been in use in the Vedic age.

## THE YEAR

Let us now consider the connotation of the two terms, the year and the month. The word *Varṣa* which at present denotes a unit of 364 or 365 days or some such interval, is not found in the same sense in the *Rk-Yaju-Saṁhitās* or the *Aitareya*, the *Taittirīya*, the *Tāṇḍya* or the *Gopatha Brāhmaṇas*, but it does occur in the *Śatapatha Brāhmaṇa* (2-2-3). In *Rigveda*, the names of seasons like Śarad have been for use denoting a year. Similarly, the words Saṁvatsara and Parivatsara are found so used in some places. In both the versions of the *Yajurveda* words like Śarad and Hemanta have not only been used several times in the sense of a year, but the word Saṁvatsara appears to have been used much more frequently. The word ‘*hāyana*’ has been used in

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धर्मासः संवत्सर आप्यते.....चतुर्विंशति रात्री-  
 दीक्षितः स्याच्चतुर्विंशतिरर्धमासाः संवत्सरः.....  
 त्रिंशतं रात्रीर्दीक्षितः स्यात् त्रिंशदक्षराविराट्  
 मासं दीक्षितः स्याद्यो मासः स संवत्सरः ॥

तै. सं. ५. ६. ७.

“One should remain consecrated for six nights, because there are six seasons in a year..... Consecration should be observed for twelve nights because there are twelve months in a year..... Consecration should last for 13 nights because the year has 13 months\* etc.”—*Taittirīya Samhitā*.

तस्य त्रीणिच शतानि षष्ठिश्च स्तोत्रीयास्तावतीः संवत्सरस्य रात्रयः

तै. सं. ७. ५. १.

“It has 360 ‘Stotriyas’ because the year has so many nights.”—*Taittirīya Samhitā*.

उपयामगृहीतोसि ॥ मधवे त्वोपयामगृहीतोसि माधवाय  
 त्वोपयामगृहीतोसि शुक्राय त्वोपयामगृहीतोसि शुचये...  
 नभसे...नभस्याय...इषे...ऊर्जे...सहसे...सहस्याय...तपसे...  
 तपस्याय...अंहसस्पतये त्वा ।

वा. सं. ७. ३०.

“(Oh Ritugraha !) You have been adopted by ‘Upayāma’ (i.e. a dish) for the Madhu.....”—*Vājasaneyī Samhitā*.

Some of the lines quoted from *Taittirīya Samhitā* (1.4.14) are almost similar to those given above. These contain similar names of the twelve months of the year, viz., Madhu, Mādhava, etc., but the last verse names the thirteenth month as ‘Amhaspati’.

The quotations “Madhusca Mādhavasca.....” from *Taittirīya Samhitā* are found in *Vājasaneyī Samhitā* also (see 13. 25, 14.6, 15, 16, 27 and 15, 57).

सं सर्पाय स्वाहा चंद्राय स्वाहा ज्योतिषे स्वाहा मलि-

म्लुचाय स्वाहा दिवापतये स्वाहा

वा. सं. २२. ३०.

मधवे स्वाहा माधवाय स्वाहा शुक्राय स्वाहा शुचये

स्वाहा नभसे स्वाहा नभस्याय स्वाहेषाय स्वाहोर्जाय

स्वाहा सहसे स्वाहा सहस्याय स्वाहा तपसे स्वाहा

तपस्याय स्वाहां हसस्पतये स्वाहा ॥

वा. सं. २२. ३१.

\*The translation of the above passage has been partly omitted in the text because it is not necessary for explaining the point. It is now given in full below.

“One should remain consecrated for 15 nights. Half a month has 15 nights. A year is made up of half-months. Remain consecrated for 24 nights, because 24 half-months make a year. Remain consecrated for 30 nights, because thirty *Akṣaras* make the *Virāt*. One should remain consecrated for a month because a month is a year”. Here a distinction is made between 30 days and a month. Similarly, looking to the reasons put forward for the observance of a period of a particular number of nights, one would expect the author to recommend the adoption of a period of 30 nights, on the plea that a month consists of 30 nights, but it is not so stated. Hence it appears beyond doubt that in the Vedic age, the lunar month was known to be slightly shorter than the period of thirty *Sāvana* (civil) days.

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are stated to be the seasons belonging to the gods. It, therefore, appears that the interpretation in vogue was that Udagāyana denoted the period during which the sun kept to the north of equator, and Dakṣiṇāyana, the one during which it kept to the south.

Some astronomical Saṁhitā works appear to use the term 'ayanas' in this very sense, for they speak of the Udagāyana as the day of the gods ; and to the gods residing on the *Mount Meru*, the sun in its northward course is continuously visible for six months, which shows that the term Udagāyana is to be applied to the continuous position of the sun to the north of the equator. The *Bhāgavata* also gives the same meaning.

तस्मादादित्यः षण्मासो दक्षिणेनैति षडुत्तरेण

तै. सं. ६. ५. ३.

In the above line of *Taittirīya Saṁhitā* it has been stated that the sun moves towards the south for six months, and towards the north for another six months. An extract from *Nirukta* regarding the progress of the soul after death has been quoted in the succeeding pages (see paragraph on *Niruka infra*) and it refers to the sun's northward and southward motion. A similar description is found in most of the *Upaniṣads*, but it is all in a general sense. With the exception of the above quotation from the *Śatapatha Brāhmaṇa*, nowhere in the Vedas any reference has been found that clearly shows what measure of time was denoted by the word 'ayana'. The words Udagāyana and Uttarāyana occur in the *Maitrāyaṇī-Upaniṣad* and in the following lines from the *Nārāyaṇa Upaniṣad* (anuvāk 80).

य.....उदगयने प्रसीयते देवानामेव महिमानं गत्वादित्यस्य सायुज्यं गच्छत्यथयो दक्षिणे प्रसीयते  
पितृणामेव महिमानं गत्वा चंद्रमस सायुज्यं सलोकतामाप्नोति.

नारायण उपनि. अनु. ८०.

Excepting these two works, all others have generally used the words Devayāna and Devaloka for Udagāyana, and Pitryāna and Pitṛloka for Dakṣiṇāyana. Nothing can definitely be said as to whether these words carried the same meaning as the word 'ayana' in the *Śatapatha Brāhmaṇa* or whether it was used also in the other sense in some other places, and as to which of the two was more ancient and when the other sense came into vogue. There is, however, no ambiguity about the interpretation of the *ayanas* as given by the astronomical works as quoted above, and this is found in all works on astronomy and is generally accepted at present.

## SEASONS

Let us now consider the question of seasons. This has already been partially discussed above.

The names of seasons like *Śarad* and *Hemanta* occur at many places in *Ṛk Saṁhitā*. The word 'Rtu', however, does not occur by itself as frequently in the *Ṛk Saṁhitā*, as it does in both the schools of *Yajurveda* and *Bahvṛca Brāhmaṇa*. The *Rigveda Saṁhitā* does not on the whole appear to attach much importance to the seasons. The 28th and 29th sections of the 3rd chapter of the 5th aṣṭakā of *Ṛk-Saṁhitā* give about 50 to 60 sentences

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“The spring is the head (of the year) ; the summer is the right wing ; the monsoon forms the tail ; autumn the left wing, and winter the central part.”

Similar statements are found at two more places. Here Hemanta is stated to be the middle of the year, and the rainy season its tail.

If the year be compared to a bird, the following chart would correctly represent the position stated above ;

|                              |                          |                               |
|------------------------------|--------------------------|-------------------------------|
|                              | (Mouth)<br><i>Spring</i> |                               |
| (Left wing)<br><i>Autumn</i> | (Belly)<br><i>Winter</i> | (Right wing)<br><i>Summer</i> |
|                              | (Tail)<br><i>Monsoon</i> |                               |

#### Commencement of Seasons

उभयतोमुखमृतुपात्रं भवति कोहि तद्वेद यद्वृत्तनां मुखं

तै. सं. ६. ५. ३.

“Two faced is the vessel of seasons ; who knows which one is the mouth of the seasons ?”

This remark seems to suggest that none can know when a particular season commences. And that is correct. The seasons depend upon the sun's position. If in a certain year a solar month begins, say, simultaneously with a lunar month, it would in the following year commence from the 12th day of the light half and in the subsequent year from the 8th day of the dark half. Therefore, the commencement of a season with respect to the tithi is irregular. Not only this, but it is somewhat irregular with respect to the sidereal solar month also. At present rains start within 4 or 5 days of either ahead or after the beginning of the nirayana Mrga nakshatra. The commencing day of a season varies from place to place also ; it is, of course, obvious that the variation would be about five to ten days ; still it was but natural for the ancients to express their thoughts as in the above quotation.

It would be very difficult to obtain an accurate knowledge of the transition moments of two half-months or those of the seasons in the absence of an accurate knowledge of the motions of the luminaries and of the means of measuring time. The following myth will show how difficult it was for the primitive man to note the ending moments of the full moon and the new moon as also the ending of one season and the beginning of the next.

प्रजापतेर्ह वै प्रजाः ससृजानस्य पवाणि विसृजंस्तुः स वै संवत्सर एव प्रजापतिस्तस्यैतानि पवाण्यहोरात्रयोः संधी पौर्णमासी चामावास्या चतुर्मुखानि ॥ ३५ ॥ स विसृजंस्तैः पवाभिः ॥ न शशाकसंहातुं तमेतैर्हविर्यज्ञैर्देवा अभिषज्यन्मग्निहोत्रेणैवाहोरात्रयोः संधी तत्पवाभिषज्यंस्तत्समदधुः पौर्णमासेन चैवामावास्येन च पौर्णमासी चामावास्यां च तत्पवाभिषज्यंस्तत्समदधु-श्चातुर्मास्यैरेवतुर्मुखानि तत्पवाभिषज्यंस्तत्समदधुः ॥ ३६ ॥

शत. ब्रा. १. ६. ३.

"After mankind was created by Prajāpati, his *parvas* (knuckles) became loose. The *samvatsara* (year) itself represented the Prajāpati. The two 'points' of day and night *i.e.* twilight, the full moon and the new moon, and the commencement of seasons—these are his *parvas*. The gods diagonalised the disorder. They cured the 'joints' of day and night and set them in their correct places by maintenance of *agnihotras* (sacred fires). The full and the new moons were correctly adjusted by the *Paurṇamāseṣṭi* and *Darśeṣṭi* and the 'joints' of the seasons were set right by means of the '*Cāturmāsya* *yajña*' (*i.e.* four monthly sacrifices)".

This story points to some kind of the association of the knowledge of time with the sacrificial system.

### THE MONTHS

Let us now consider the question of the month. It has already been dealt with at some length in the course of the discussion under the heading 'The Year'. Madhu and other names of months have already appeared in the foregoing discussion. In addition to this, some more names are found in Taittiriya Brāhmaṇa and they are now being given in the following quotations which include some different names of seasons and half-months also :—

अथ यदाह ॥ पवित्रं पवयिष्यन्त्सहस्वान्त्सहीयानरुणोरुणरजा इति ॥ एष एव तत् ॥  
एष ह्येव तेर्वमासाः ॥ एष मासाः ॥ अथ यदाह ॥ अग्निष्टोम उक्थ्योऽग्निर्ऋतुः प्रजापतिः  
संवत्सर इति ॥ एष एव तत् ॥ एष ह्येव ते यज्ञक्रतवः ॥ एष ऋतवः ॥ एष संवत्सरः ॥

तै. ब्रा. ३. १०. ६.

The half-months referred to above are given in the following list. These are the names of the 24 half-months occurring in one year :—

- |              |  |            |
|--------------|--|------------|
| 1 पवित्रं    | पवित्रं पवयिष्यन् पूतो मेध्यः ॥ यज्ञो यज्ञस्वानायुरमृतः ॥        | 9 जीवः     |
| 2 पवयिष्यन्  | जोवो जीविष्यन्त्स्वर्गो लोकः ॥ सहस्वान् सहीयानो जस्वान् सहमानः ॥ | 10 जीविष्य |
| 3 पूतो       | जयन्तभिजयन्त्सुद्रविणी द्रविणोदाः ॥                              | 11 स्वर्गो |
| 4 मेध्यः     | आर्द्रपवित्रो हरिकेशो मोदः प्रमोदः ॥                             | 12 सहस्वा  |
| 5 यज्ञो      |  | 13 सहीयान  |
| 6 यज्ञस्वान् |  | 14 जस्वान् |
| 7 यज्ञमृतः   |  | 15 सहमानः  |
- These are the names of 24 half-months occurring in a year.

Following is the list of names of months.

- |                |                                 |               |
|----------------|---------------------------------|---------------|
| 1 अरुणोरुणरजाः | पुंडरीको विश्वजिदभिजित् ॥       | 7 पितृमासः    |
| 2 आर्द्रः      | पिन्वमानोऽश्विनो रसवानिरावान् ॥ | 8 अश्विन      |
| 3 सर्वाष्वधः   | संभरो महस्वान् ॥                | 9 रसवान्      |
| 4              |                                 | 10 अश्विन     |
| 5              |                                 | 11 सर्वाष्वधः |
| 6              |                                 | 12 संभरो      |
|                |                                 | 13 महस्वान्   |

It contains 13 names, apparently including that of the intercalary month.

अग्निर्ऋतुः सूर्य ऋतुश्चंद्रमा ऋतुः ॥

तै. ब्रा. ३. १०. १.

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“Fire should not be kindled on the Pūrva Phalgunī nights ;’ (since) Pūrva Phalgunī is the last night of the year. It should be kindled on the Uttara Phalgunī. This is the first night of the year.”

Although the word ‘full moon night’ is not explicitly mentioned here, still the full moon night when the Pūrva Phalgunī stars come together with the full moon, appears to be implied in it. That the moon becomes full near the Phalgunī nakṣatra is the idea suggested by these words. However, not only the word Phālguna does not occur in it, but even the word “*Phalgunī-purnamāsa*” does not occur in it as it does in the lines quoted above from the *Samhitā*.

The above lines show that the phenomenon of the moon becoming full near certain stars had been noticed in the times of *Taittirīya Samhitā* and *Brāhmaṇa*. Still it must be remembered that the names Caitra etc., had definitely not come into vogue in those times.

एषा ह संवत्सरस्य प्रथमा रात्रिर्या फाल्गुनी पूर्णमासी ॥

शतपथब्राह्मण ६. २. २. १८.

फाल्गुन्यां पौर्णमास्यां चातुर्मास्यानि प्रयुज्यते । मुखं वा एतत्संवत्सरस्य यत्फाल्गुनी पौर्णमासी ॥

गोपथब्राह्मण. ६. १६.

The words “*Phālgunī Purnamāsi*” occur in this. Even the *Sāṅkhyāyana Brāhmaṇa* (which the author has not seen) is said to contain the following line:—

या वैषा फाल्गुनी पौर्णमासी संवत्सरस्य प्रथमा रात्रिः ॥

Any way, the word ‘Phālgunī’ occurring in all these quotations only means “associated with the Phalgunī star”. The words ‘Phālgunī Purnamāsi’ occurring in *Śatapatha Brāhmaṇa* (2-6-3) has been defined by Sāyanācārya as “that full moon night which becomes associated with the two Phalgunī asterisms is known as the Phalgunī”. The *Sāmavidhāna Brāhmaṇa* (2.4) contains the line,

या रौहिणी वा पौषी वा पौर्णमासी.

सामवि. ब्रा. २. ४.

In this ‘Rauhiṇī’ simply means “associated with Rohiṇī star”, it has nothing to do with the ‘Rauhiṇa’ month. Similarly, the Pausī, the Phalgunī, etc., stand for those full moon nights which are associated with the stars of corresponding names. In short, it can be said that only the terms ‘Phālgunī’ etc., had come into vogue at the time when *Brāhmaṇa* works were compiled. Nowhere in the *Samhitā* and *Brāhmaṇa* do the words Phālguna, Caitra, etc., occur in the sense of names of months, and this shows that these terms were not then in vogue. Much time must necessarily have elapsed before the term Phālguna, Caitra etc., came into vogue, even when the terms Phalgunī, etc., had gained currency. This point can be easily understood if one considers as to how long a time has to elapse before a scientific theory becomes an established truth.

In short, the terms Caitra, etc., were not in vogue in the *Samhitā* and *Brāhmaṇa* period. Thus it can be proved from the historical point of view that these terms came into use after a very long period of time after the terms Madhu, etc., became current.



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next month. The rule about the full moon's proximity with certain stars would be easily discovered, if after the completion of 12 lunar months the moon becomes full near the same star in the second round of 12 months as in the first.

But it so happens that if it is found to be full near, say, Aśvinī, in the first month of the first round, it would appear to have become full near Revatī in the first lunar month of the second round. It is also not true that the moon becomes full only near those 12 asterisms to which Caitra and other lunar months owe their origin. As a matter of fact, it becomes full near each of the 27 asterisms in some month or the other. There is still another difficulty ; there are only four out of the 27 stars which do not fade but remain visible even when the full moon is in close proximity with them, and they are Maghā, Jyeṣṭhā, Citrā and Rohiṇī. Some of the rest become invisible when the moon approaches them within a distance of 7° to 8° and there are still others which fade away in the moon's lustre when it is still further away. In short, it is obvious that long time must have elapsed before the rule about the moon's becoming full near particular stars could be established after the asterisms received their names. The next stage was the application of the names Caitrī, Vaiśākhī, etc., to the full moons, and the stage next to this was the naming of lunar months after the stars.

In short, it is proved, from the natural order of progress and from the historical point of view, that the terms Caitra etc. came into vogue when considerable time had elapsed after the introduction of names like Madhu, etc.

### *The Solar Months*

References to the civil and lunar months are definitely found in the Vedas ; but an explicit mention of solar months is not found anywhere in them. The solar month is the time which the sun takes to cross each of the 12 equal divisions of the 'bhacakra' (zodiac). Meṣa and other names of Rāśis are not found in the Vedas ; but that is immaterial. But even a corresponding set of names for the 12 equal divisions of the 'bhacakra' are also not found anywhere. Now, it cannot be said for certain that Madhu-Mādhava given in the Vedas as names of months were not the names of solar months for, while their connotation indicates some relationship with the seasons, that is indirectly with the sun, they are also used as synonyms for the seasons (see page 18). We do not, however, find any statement that they ended on days other than the full moon or the new moon days. On the other hand, we find it definitely mentioned that months end either on the full moon day or the new moon day. Hence, these appear to be the names of lunar months or in other words of the months which end on full moon or new moon days. The year, however, was undoubtedly solar, hence why should it be considered improbable that solar months different in measure from lunar months were also in vogue ? In all probability, they were in current use and there are grounds to believe that just as Madhu and other names were applied to lunar months they were equally applicable to solar months also.

### *The Amānta and Pūrṇimānta Months*

Let us now see if the months were Pūrṇimānta or Amānta. That month which ends with Amāvasyā or the new moon is called Amānta and the one which ends in Pūrṇimā or the full moon is called Pūrṇimānta. Both these

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This clearly gives the names of the five parts, viz., prātaḥ, sangava, madhyāhna, aparāhṇa and sāyam.

आदित्यस्त्वेव सर्वं ऋतवः । यदैवोदेत्यथ वसंतो यदा संगवोथ ग्रीष्मो यदा मध्यंदिनोथ वर्षा  
यदापराह्णोथ शरद्वदेवास्तमेत्यथ हेमंतः ॥ शत. ब्रा. २. २. ३. ६.

तस्मा उद्यन्तसूर्यो हिंकृणोति संगवः प्रस्तौति मध्यंदिन उद्गायत्यपराह्णः प्रतिहरत्यस्तं  
यन्निधनं ॥ अथ. सं ६. ६. ४६.

Here the names 'sangava', 'madhyāhna', and 'aparāhṇa' do not seem to denote the parts of the day, but the transition moments of the four 'praharas' of the day.

Mādhava, in his work *Kālamādhava*, while considering the five-fold division of the day, quotes the abovementioned anuvāk from Taittirīya Brāhmaṇa and observes that "the passage seems to describe the creation of the four systems of soma-sacrifices known as 'agniṣṭoma', 'ukthya' 'śoḍaśi and 'atirātra' which are to be performed at the four transition moments in the five divisions of the day and remarks that the five-fold division of the day is found in many 'śruti's and 'smṛti's." The line\* "*pradoṣānto homākālāḥ sangavāntaḥ prātaḥ*" occurs in the *Āsvalāyana Sūtra* shows that 'sangava' is a part of the day and not a transition moment between two parts.

### FIFTEEN MUHŪRTAS

The Taittirīya Brāhmaṇa states the names of 15 muhūrtas (or parts) of the day and similar 15 of the night.

अथ यदाह ॥ चित्रः <sup>१</sup>केतुर्दाता <sup>२</sup>प्रदाता <sup>३</sup>सविता <sup>४</sup>प्रसविता <sup>५</sup>भिज्ञास्तानुमंतेति ॥

एष एव तत् ॥ एष ह्येव तेन्हो मुहूर्ताः ॥ एष रात्रेः ॥

तै. ब्रा. ३. १०. ६.

The divisions referred to in the above lines have all been mentioned in a single anuvāk in the same Brāhmaṇa a little earlier. They are :—

चित्रः <sup>१</sup>केतुः <sup>२</sup>प्रभाना <sup>३</sup>भान्तं <sup>४</sup>संभान् ॥ <sup>५</sup>ज्योतिष्मांस्ते <sup>६</sup>जस्वाना <sup>७</sup>तपंस्तपन् <sup>८</sup>भितपन् ॥  
<sup>९</sup>रोचनो <sup>१०</sup>रोचमानः <sup>११</sup>शोभनः <sup>१२</sup>शोभमानः <sup>१३</sup>कल्याणः ॥

तै. ब्रा. ३. १०. १.

These are the names of 15 muhūrtas of the day in the light half of the month ; each line mentions five and in all they are fifteen in number.

<sup>१</sup>दाता <sup>२</sup>प्रदाता <sup>३</sup>ज्जदो <sup>४</sup>मोदः <sup>५</sup>प्रमोदः ॥ <sup>६</sup>आवेशग्निवेशयन् <sup>७</sup>संवेशनः <sup>८</sup>संशान्तः <sup>९</sup>शान्तः ॥  
<sup>१०</sup>आभवन् <sup>११</sup>प्रभवन् <sup>१२</sup>संभवन् <sup>१३</sup>संभूतो <sup>१४</sup>भूतः ॥

तै. ब्रा. ३. १०. १. १. २.

\*Translation—'The ending moment of the 'pradoṣa' part is the proper time for offering oblations into fire and the end of 'sangava' is termed 'prātaḥ'.'

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star groups but to stars in general which are scattered all over the sky. Some of these mantras are found in the Atharva Saṁhitā also.

अप त्वे तावयो यथा नक्षत्रा यंत्यक्तुभिः ॥ सूराय विश्वचक्षसे ॥

ऋ. सं. १. ५०. २. अथ. सं. १३. २. १७; २०. ४७. १४.

“The stars and the night escape like thieves on the approach of the all-seeing sun”.

अभि श्यावं न कुशनेभिरश्वं नक्षत्रेभिः पितरो द्यामपिंशन् ॥

ऋ. सं. १०. ६८. ११.

The term ‘nakṣatra’ has been applied to the stars in the above two lines.

In the line, “*Dyaauriva smayamāno nabhobhiḥ*” (meaning like the sky adorned with stars), the word ‘nabhas’ is used in the sense of stars ; the word “*rocanā*” also appears in that sense at some other places.

द्यावो न स्तुभिश्चितयंत ॥ ऋ. सं. २. ३४. २.

ऋतावानं विचेतसं पश्यंतो द्यामिव स्तुभिः ॥

ऋ. सं. ४. ७. ३.

In these lines the word ‘*stṛ*’ has been used to denote stars.

In the first two ṛcās the word ‘nakṣatra’ has been used to denote the stars in general and not only those stars which lie on the path of the moon. The term ‘nakṣatra’, as used in the post-Vedic Sanskrit works, denotes stars in general as well as those lying on the path of the moon.

अथो नक्षत्राणामेषामुपस्थे सोम आहितः ॥

ऋ. सं. १०. ८५. २. अथ. सं. १४. १. २.

“The moon is placed amongst the stars”.

Here, the word nakṣatra seems to have been applied only to those stars which are situated in the moon’s path.

The Ṛk Saṁhitā does not mention names of all the 27 nakṣatras in the moon’s path, but only a few of them. The word ‘*tisya*’ which occurs in 5-54-13 and 10-64-8 appears to denote the star ‘Puṣya’. The name *Citrā* nakṣatra occurs in 4-51-2 and *Revatī* in 4-51-47 ; this appears to denote the star ‘Revatī’. The next ‘ṛcā’ mentions two ‘nakṣatras’ in succession.

सूर्याया बहुलुः प्रागात् सवितायमवासृजत् ॥ अघासु हन्यंते गावोर्जुन्योः पर्युह्यते ॥

ऋ. सं. १०. ८५. १३.

“The (dowry) of cows which was given by Savitā (sun) had already gone ahead of Suryā. They drive\* the cows on the Aghā (Maghā) nakṣatra. The (daughter) was carried away on the Arjunī (Phalgunī) star”.

\*The verbal root ‘han’ here does not mean ‘to kill’. The Marathi ‘hāṇaṇe’ is quite current even at present in the Sholapur district in the sense of lashing or beating and driving.

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A good many references to nakṣatras are found in the Taittiriya Śruti. At some places the names of all the nakṣatras and those of their controlling deities have been mentioned. At some other places we get many kinds of descriptions about them, at others, is described the origin of their names, and at still other places, we come across casual references of intermediate stars at random.

The following anuvāk from Taittiriya Samhitā mentions all the nakṣatras :—

१ कृत्तिका नक्षत्रमग्निदेवताग्नेरुचस्थ प्रजापतेर्धातुः सोमस्यर्चं त्वा रुचे त्वा द्युते त्वा भासे त्वा ज्योतिषे त्वा रोहिणी<sup>२</sup> नक्षत्रं प्रजापतिदेवता मृगशीर्षं<sup>३</sup> नक्षत्रं सोमो देवता द्रविक्षत्रं<sup>४</sup> द्रवो देवता पुनर्वसु<sup>५</sup> नक्षत्रमदितिदेवता तिष्यो<sup>६</sup> नक्षत्रं बृहस्पतिदेवताश्रेषो<sup>७</sup> नक्षत्रं सर्पा देवता मघा<sup>८</sup> नक्षत्रं पितरो देवता फल्गुनी<sup>९</sup> नक्षत्रमर्यमा देवता फल्गुनी<sup>१०</sup> नक्षत्रं भगो देवता हस्तो<sup>११</sup> नक्षत्रं सविता देवता चित्रा<sup>१२</sup> नक्षत्रमिन्द्रो देवता स्वाती<sup>१३</sup> नक्षत्रं वायुदेवता विशाखं<sup>१४</sup> नक्षत्रमिन्द्राग्नी देवतानुराधा<sup>१५</sup> नक्षत्रं मित्रो देवता रोहिणी<sup>१६</sup> नक्षत्रमिन्द्रो देवता विचित्रो<sup>१७</sup> नक्षत्रं पितरो देवताषाढा<sup>१८</sup> नक्षत्रमापो देवताषाढा<sup>१९</sup> नक्षत्रं विश्वेदेवा देवता श्रौणा<sup>२०</sup> नक्षत्रं विष्णुदेवता श्रविष्ठा<sup>२१</sup> नक्षत्रं वसवो देवता शतभिषे<sup>२२</sup> नक्षत्रमिन्द्रो देवता प्रोष्ठपदा<sup>२३</sup> नक्षत्रमजएकपादेवता प्रोष्ठपदा<sup>२४</sup> नक्षत्रमर्हर्बुध्नयो देवता रेवती<sup>२५</sup> नक्षत्रं पूषा<sup>२६</sup> देवताऽश्वयुजो<sup>२७</sup> नक्षत्रमश्विनो देवतापभरणी<sup>२८</sup> नक्षत्रं यमो देवता पूषापिश्चाद्यस्ते देवा अदधुः ॥

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तै. सं. ४. ४. १०.

The Taittiriya Brāhmaṇa gives lists of all the nakṣatras with their deities at three places ; the anuvāk is quoted below because it gives a quaint description :—

अग्नेः कृत्तिकाः ॥ शुक्रं परस्ताज्ज्योतिरवस्तात् ॥ प्रजापते रोहिणी ॥ आपः परस्तादोष-  
धयोवस्तात् ॥ सोमस्येन्वका विततानि ॥ परस्तात् वयंतोवस्तात् ॥ रुद्रस्य बाहू ॥ मृगश्वः<sup>३</sup>  
परस्ताद्विश्वरोजवस्तात् ॥ अदित्यं पुनर्वसु<sup>५</sup> ॥ वातः परस्तादादमवस्तात् ॥ बृहस्पतेस्तिष्यः ॥ (५७५)  
जुह्वतः परस्ताद्यजमाना अवस्तात् ॥ सर्पाणामाश्रेषाः<sup>७</sup> ॥ अभ्यागच्छंतः परस्तादभ्यागत्यंतोव-  
स्तात् ॥ पितृणां मघाः<sup>८</sup> ॥ ऊदंतः परस्तादपभ्रंशोवस्तात् ॥ अर्यम्णः पूर्वं फल्गुनी<sup>९</sup> ॥ जाया  
परस्तादवृषभोवस्तात् ॥ भगस्योत्तरे<sup>१०</sup> ॥ बहवः परस्ताद्वहमाना अवस्तात् ॥ देवस्य सवितु-  
हस्तः<sup>११</sup> ॥ प्रसवः परस्तात्सनिखस्तात् ॥ इंद्रस्य चित्रा<sup>१२</sup> ॥ ऋतं परस्तात्सत्यमवस्तात् ॥  
स्वाती<sup>१३</sup> वायोनिंष्ट्या व्रतति<sup>१४</sup> ॥ परस्तादसिद्धिरवस्तात् ॥ इंद्राग्नियोर्विशाखं<sup>१५</sup> ॥ युगानि परस्तात्कृष-  
माणा अवस्तात् ॥ मित्रस्यानुराधाः<sup>१६</sup> ॥ अभ्यारोहपरस्तादभ्यारूढमवस्तात् ॥ इंद्रस्य रोहिणी<sup>१७</sup> ॥ (५७६)  
शृणुपरस्तात्प्रतिशृणुदवस्तात् ॥ निऋत्यं मूलबर्हणी<sup>१८</sup> ॥ प्रतिभजंतः परस्तात्प्रतिशृणंतोवस्तात् ॥  
अपां पूर्वा अषाढाः<sup>१९</sup> ॥ वर्चः परस्तात्समितिरवस्तात् ॥ विश्वेषां देवानामुत्तरीः<sup>२०</sup> ॥ अभिजय-  
त्परस्तादाभिजितमवस्तात् ॥ विष्णोः श्रौणा<sup>२१</sup> पृच्छमानाः<sup>२२</sup> ॥ परस्तात्पथा अवस्तात् ॥ वसूनां  
श्रविष्ठाः<sup>२३</sup> ॥ भूतं परस्ताद्वृत्तिरवस्तात् ॥ इंद्रस्य शतभिषे<sup>२४</sup> ॥ विश्वव्यचाः परस्ताद्विश्वा-  
क्षितिरवस्तात् ॥ अजस्यैकपदः पूर्वं प्रोष्ठपदा<sup>२५</sup> ॥ वैश्वानरं परस्ताद्वैश्वानरमवस्तात् ॥  
अहेर्बुध्नयस्योत्तरे<sup>२६</sup> ॥ अभिषिचंतः परस्तादभिषृण्वंतोवस्तात् ॥ पूषो रेवती<sup>२७</sup> ॥ गावः  
परस्तात् वत्सा अवस्तात् ॥ अश्विनोऽश्वयुजौ<sup>२८</sup> ॥ ग्रामः परस्तात्सेनावस्तात् ॥ यमस्याप-  
भरणाः ॥ अपकर्षंतः परस्तादपवहंतोवस्तात् ॥ पूषापिश्चाद्यस्ते देवा अदधुः ॥

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तै. ब्रा. १. ५. १.



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| No. | Name of Nakṣatra               | The controlling Deity | Gender    | Number   |
|-----|--------------------------------|-----------------------|-----------|----------|
| 8   | Maghā . . . .                  | Pitṛ                  | Feminine  | Plural   |
| 9   | (1, 3, 4) Phalgunī . . . .     | Aryamā                | „         | Dual     |
|     | (2) Pūrva Phalgunī . . . .     | „                     | „         | „        |
| 10  | (1, 3, 4) Phalgunī . . . .     | Bhaga                 | „         | „        |
|     | (2) Uttara Phalgunī . . . .    | „                     | „         | „        |
| 11  | Hasta . . . .                  | Savitā                | Masculine | Singular |
| 12  | Citrā . . . .                  | (1, 2) Indra          | Feminine  | „        |
|     |                                | (3, 4) Tvaṣṭā         | „         | „        |
| 13  | (1) Svātī . . . .              | Vāyu                  | „         | „        |
|     | (2, 3, 4) Niṣṭyā . . . .       | „                     | „         | „        |
| 14  | Viśākhā . . . .                | Indrāgni              | „         | Dual     |
| 15  | Anūrādhā . . . .               | Mitra                 | „         | Plural   |
| 16  | (1, 2) Rohiṇī . . . .          | Indra                 | „         | Singular |
|     | (3, 4) Jyeṣṭhā . . . .         | „                     | „         | „        |
| 17  | (1) Viçṛtau . . . .            | Pitṛ                  | Masculine | Dual     |
|     | (2) Mūla Barhaṇī . . . .       | Nirṛti                | Feminine  | Singular |
|     | (3) Mūla . . . .               | „                     | Neuter    | „        |
|     | (4) Mūla . . . .               | Prajāpati             | „         | „        |
| 18  | (1, 3, 4) Aṣāḍhā . . . .       | Āpaḥ                  | Feminine  | Plural   |
|     | (2) Pūrvāṣāḍhā . . . .         | „                     | „         | „        |
| 19  | (1, 3, 4) Aṣāḍhā . . . .       | Viśvedeva             | „         | „        |
|     | (2) Uttarāṣāḍhā . . . .        | „                     | „         | „        |
| 19A | (3, 4) Abhijit . . . .         | Brahma                | Neuter    | Singular |
| 20  | Śroṇā . . . .                  | Viṣṇu                 | Feminine  | „        |
| 21  | Śraviṣṭhā . . . .              | Vasu                  | „         | Plural   |
| 22  | Śataviṣak . . . .              | (1, 2) Indra          | Masculine | Singular |
|     |                                | (3, 4) Varuṇa         | „         | „        |
| 23  | (1, 3, 4) Proṣṭhapada . . . .  | Ajackapād             | „         | Plural   |
|     | (2) Pūrva Proṣṭhapada . . . .  | „                     | „         | „        |
| 24  | (1, 3, 4) Proṣṭhapada . . . .  | Ahīrbudhniya          | „         | „        |
|     | (2) Uttara Proṣṭhapada . . . . | „                     | „         | „        |

|    | Name of Nakṣatra     | The controlling Deity | Gender   | Number   |
|----|----------------------|-----------------------|----------|----------|
| 25 | Revati . . . . .     | Pūṣā                  | Feminine | Singular |
| 26 | Aśvayuja . . . . .   | Aśvin                 | „        | Dual     |
| 27 | Apabharaṇi . . . . . | Yama                  | „        | Plural   |

The derivation of the word nakṣatra has been given by Taittirīya Brāhmaṇa in the following lines :—

प्रबाहुवा अग्रे क्षत्राण्यातेपुः ॥ तेषामिन्द्रः ॥ क्षत्राण्यादत्त ॥

नवा इमानि क्षत्राण्यभूर्वाग्निति ॥ तन्नक्षत्राणां नक्षत्रत्वं ॥

तै. ब्रा. २. ७. १८. ३.

This, in short, appears to mean that those which are not 'Kṣatra' (movable) are Nakṣatras. The Nirukta, explaining that the term nakṣatra is derived from its quality of being *movable* and adds that according to the Brāhmaṇas the nakṣatras are so called because they are not 'Kṣatra' (*i.e.* movable). The Taittirīya Brāhmaṇa at another place writes as follows :—

सलिलं वा इदमंतरासीत् ॥ यदतरन् ॥ तत्तारकाणां तारकत्वं ॥ यो वा इह यजते ॥  
अमुं स लोकं नक्षत्र ॥ तन्नक्षत्राणां नक्षत्रत्वं ॥ देवगृहा वै नक्षत्राणि ॥ य एवं वेद ॥  
गृह्येवभवति ॥ यानि वा इमानि पृथिव्याश्चित्राणि ॥ तानि नक्षत्राणि ॥ तस्मादश्लीलनामं  
श्चित्रे ॥ नावस्येन्नयजेत ॥ यथा पापाहे कुरुते ॥ तादृगेव तत् ॥

तै. ब्रा. १. ५. २.

“There was water in the centre. The tārakās (stars) are said to possess the property of tārakatva (protectiveness) because they floated and saved themselves. He who performs a sacrifice here goes (nakṣate) to that world. Hence is the 'nakṣatra' significantly so called. They are the houses of gods. He who knows this becomes the owner of a house. The nakṣatras are the images of the earthly objects. Hence a rite should not be allowed to terminate and a sacrifice should not be performed on an ugly nakṣatra ; it gives the same result as a rite performed on an inauspicious day”.

These lines are very important as the derivation of the word *tārakā* appears more to be quibbling, but the second derivation which traces the word to the root “nakṣa” (to go) and the notion that the virtuous in this world should ascend the heaven and become nakṣatras, is noteworthy. Several nations of the world might be cherishing this belief. The idea that the nakṣatras are houses of gods is very important. Here, what can the word ‘deva’ stand for other than the shining planets, actually moving through the stars? The notion that the nakṣatras are the houses (*grhas*) of gods suggested the derivation that what holds (*grhṇāti*) a house is a (*graha*) planet and thus the word *graha* (planet) seems to have been applied to resplendent gods like Venus etc.

Looking to the derivation of the word nakṣatra that they are the images or pictures of the earth or earthly objects, it appears that the nakṣatras must have derived their names from their resemblance to particular figures. But some nakṣatras seem to have received their names for other reasons.

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“The Saptarṣis were called bears in ancient times”

There is a reference to the seven stars (Saptarṣis) in Tāṇḍya Brāhmaṇa (1. 5. 5.) which is as follows :—

ऊर्ध्वं सप्त ऋषीनुपतिष्ठस्व ॥

तांड्य ब्रा. १. ५. ५.

“Worship the seven sages (appearing) above.”

In Taittirīya Brāhmaṇa we come across the following lines in which some reference to the star Citrā occurs after the suggestions that sacrifice should be commenced on the Kṛttikā nakṣatra.

कालकंजा वै नामासुरा आसन् ॥ ते सुवर्गाय लोकायाग्निमचिन्वत ॥ पुरुष इष्टकामुपाधत्त ॥ पुरुष इष्टकाम् ॥ स इन्द्रो ब्राह्मणो ब्रुवाण इष्टकामुपाधत्त ॥ एषा मे चित्रानामेति ॥ ते सुवर्गे लोकमाप्रारोहन् ॥ स इन्द्र इष्टकामावृहत् ॥ तेवाकीर्यन्त ॥ येवाकीर्यन्त ॥ त ऊर्णाविभयोभवन् ॥ द्वावुदपततां ॥ तौ दिव्यौ श्वानावभवतां ॥

तै. ब्रा. १. १. २.

From this it is clear that the words “The two which went up became divine dogs” refer to some two stars or clusters of stars.

शुनो दिव्यस्य यन्महस्तेना ते हविषा विधेम ॥ २ ॥ ये त्रयः कालकंजा दिवि देवा इव श्रिताः ॥ तांस्सर्वानवह ऊतये ॥

अथ. सं. ६. ८०.

This refers to a divine (celestial) dog and three god-like *Kālakaṇja* (demons) stars in the sky.

यौ ते श्वानौ यम रक्षितारौ चतुरक्षौ पथिरक्षौ नृचक्षसौ

ऋ. सं. १०. १४. ११.

This refers to two dogs. Even the Atharva Saṃhitā (18. 2. 12) gives this mantra with the variant reading “Pathiṣadī nṛcakṣasā” for the last two words.

There are two star clusters on either side of the Milky Way situated to the east of Mṛga constellation. They are known as Canis Major and Canis Minor in European astronomy. The first group contains Sirius, one of the brightest stars. The second group contains the pair of southern stars out of the four stars of Punarvasu. It seems these two clusters are the two dogs mentioned in the Vedas.

दैवीं नावं स्वरित्रामनागसमन्त्रवंतीमारुहेमा स्वस्तये ॥

ऋ. सं. १०. ६३. १०.

This ṛcā refers to the celestial boat. The Atharva Saṃhitā (7. 6. 3) gives this mantra as “*Daivīm... gasom asra...*”.

हिरण्ययी नौरचरद्विरण्यबंधना दिवि ॥ तत्रामृतस्य पुण्यं देवाः कुष्टमवन्वत ॥

अथ. सं. ५. ४. ४; ६. ६५. २.

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that the 'rcās' quoted above describe a total eclipse of the sun, still the description does not betray a high degree of amazement or horror. This shows that in those times eclipses had become quite familiar and the dread of that phenomenon had lost much of its edge. Secondly, what are we to understand from the remark that "the Atri alone could restore the sun and no one else could do it"? This perhaps shows that only the members of the Atri family and no one else had the knowledge of the solar eclipse. And what is meant by no one else had that knowledge? Even a child knows it when an eclipse begins. But even then we are told that Atri alone was able to liberate the sun. This means that Atri alone knew when the eclipse would end and no one else had that knowledge which Atri possessed. This shows that the descendants of the Atri family had at least some knowledge of eclipses, if not, the most accurate knowledge necessary for predicting the exact moment of the beginning and ending of an eclipse just as the ancient Chaldeans knew that the eclipses recur with every cycle of 6586 days or 223 lunar months.

Thirdly, though the wish is once expressed in these Rks that Rāhu may not devour the sun, it is said three or four times that Rāhu engulfed the sun in darkness, which means that Rāhu and darkness are regarded as two different things. A quotation regarding the belief that the moon enters the sun on the new moon day has already been given from the Aitareya Brāhmaṇa. It appears from this that even though the true cause of a solar eclipse might not have been known at the time of the eclipse mentioned above, one may safely say that the popular beliefs of those times had a leaning towards the knowledge of the true causes. The notion that Svarbhānu or Rāhu devours the sun must have gained ground at a later date.

The *Tāṇḍya Brāhmaṇa* refers to eclipses at five places (4.5.2 ; 4.6.13 ; 6.6.8 ; 14.11.14.15 ; 23.16.2), in which the 'Svarbhānu' is described as attacking the sun with darkness. In two places (6.6.8 ; 14.11.14, 15) out of five, the sage Atri is said to have removed the darkness by 'bhāsa' (lustre) ; in the remaining three places, gods are said to have removed the darkness ; but even in those places, the word 'gods' appears to mean the sun's rays. In *Gopatha Brāhmaṇa* (8.19), the 'svarbhānu' is described as having attacked the sun by means of 'tama' (darkness) and Atri is said to have driven away that 'tama'. According to a description in the *Śatapatha Brāhmaṇa* (5.3.2.2.) the 'Svarbhānu' is said to have attacked the sun with 'tama' but Soma and Rudra are said to have removed that darkness.

### PLANETS

Let us now see what the Vedas have to say about planets. It need not be told that of the nine planets, the Sun and the Moon together share hundreds of references in the Vedas. Rāhu and Ketu are not visible planets at all. Therefore, the remaining five are the only real planets belonging to the solar system. But the author did not come across any reference in the Vedas in which something is explicitly said about all or any of the five planets. There is, however, ample scope for inference.

अमी ये पंचोक्षणो मध्ये तस्थुर्महो दिवः ॥

देवत्रा नु प्रवाच्यं सध्रीचीना नि वावृतुवित्तं मे अस्य रोदसी ॥

ऋ. सं. १. १०५. १०.

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“Oh Aśvins ! You have kept one lustrous wheel of your chariot near the sun for adorning him and you revolve round the world by the second wheel.”

Of these remarks, the first one viz., ‘you have kept the lustrous wheel near the sun’ very fittingly applies to Venus and the second viz., ‘you revolve round the world by the second wheel’ applied to Jupiter equally fittingly.

The Nirukta includes Aśvins in the list of celestial deities. The time prescribed for offering prayers to them was after midnight. The dawn (Ūṣā) was always associated with the Aśvins in some way or the other in the hymns addressed to them in the Rīgveda. Habitually rising with the lark, our ancient Ṛṣis were bound to feel the attraction of the sky.

These facts lend support to our surmise and all things considered, we feel convinced that the “Twin Aśvins” were originally none else than the planets Jupiter and Venus.

We come across an independent reference showing that Jupiter was known to be a planet.

बृहस्पतिः प्रथमं जायमानो महो ज्योतिषः परमे व्योमन् ॥

ऋ. सं ४. ५०. ४. अथ. सं २०. ८८. ४.

“Jupiter was first born in the highest heaven of shining light.”

This sentence occurs also in Taittirīya Brāhmaṇa (2.8.2). The idea conveyed therein seems to be that Jupiter is a god in the form of a star. The Taittirīya Brāhmaṇa further says :—

बृहस्पतिः प्रथमं जायमानः ॥ तिष्यं नक्षत्रमभिसंबभूव ॥

ते. ब्रा. ३. १. १.

“Jupiter when born was first visible near the star Tiṣya (Puṣya)”.

The maximum latitude of Jupiter is 1° 30'. Hence, there are only 6 out of 27 nakṣatras viz., Puṣya, Maghā, Viśākhā (Alpha Libra), Anurādhā, Śatabhiṣak and Revatī with whom Jupiter can form a close conjunction. Sometimes Jupiter and the star Puṣya are so closely conjoined that they together appear to be one body. The idea of Jupiter having been born near Puṣya star might have arisen when Jupiter was seen emerging from such occultations. Evidently this would call for the knowledge of Jupiter's motion, that is to say, the knowledge that Jupiter was a ‘wandering star’ or planet. The presiding deity of Tiṣya is Bṛhaspati. Even now the conjunction of Jupiter and Puṣya is regarded as the most auspicious.

*Contd. from previous page*

Venus rose heliacally in the east on 26th September and Jupiter rose in the east on 21st November. The two, therefore, began to be seen in the eastern sky before dawn from 21st November. Now they are being seen very near together for the last 2 or 3 days. They will come nearest to each other after about two days, i.e. on 2nd January 1888, that is to say they will be in conjunction. About 1st of June, while Venus will still be seen rising in the east, Jupiter will be seen on the point of setting in the west, and after a few days Venus will disappear in the east. A gentleman who had no knowledge of astronomy, pointed out to me, of his own accord, early in the morning that two planets were situated near each other. It is not, therefore, possible that the attention of our ancient sages was not drawn to Jupiter and Venus in the same way when they conjoined. —The Author

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beyond doubt that during the Yajurveda Saṁhitā age and during all the Vedic times later, the year used to commence from the month of Madhu and with Spring. The people then might have been occasionally commencing the year from some other season for civil purposes ; but as a rule the year used to commence from Spring. Now the months were lunar and the seasons depend upon solar year ; and if a particular solar year began with the beginning of a lunar year, there being difference of 11 days in the two units of time, the beginning of Spring will not invariably coincide with the beginning of the lunar year and Spring used to set in invariably in the month of Madhu ; there is no doubt that the system of commencing the year with the month of Madhu was in use in the Yajurveda Saṁhitā age and even in later periods.

Some other astronomical features of the Vedic age will be dealt with in the conclusion of Part I.

### ASTRONOMY

It seems that the science of astronomy had assumed a tangible shape in the Vedic period. The *Vājasaneyi Saṁhitā* contains the following lines :—

प्रज्ञानाय नक्षत्रदर्श ॥

वा. सं. ३०. १०.

यादसे गणकं ॥

वा. सं. ३०. २०.

- (i) “(Go to) an observer of stars for special knowledge” and  
(ii) “a calculator for Yadasa..”

The first of these quotations occurs even in Taittirīya Brāhmaṇa (3. 4. 1). The words *gaṇaka* and *nakṣatra darśa* occur here. The Taittirīya Brāhmaṇa (3. 4. 1) mentions also the names of certain sages who were proficient in these sciences. It is stated at one place that a certain sage named Mātsya got some rite performed on an auspicious nakṣatra and it proved beneficial (1.5.2). The anuvāk which contains the names etc. of the month in a year, the days and nights of the month, and muhūrtas and pratimuhūrtas which has already been quoted above has the following lines at the end :—

जनको ह वैदहः ॥ अहोरात्रैः समाजगाम ॥ तं होचुः ॥ यो वा अस्मान् वेद ॥  
विजहत्याप्मानमेति ॥ ६ ॥ .....अभिस्वर्गं लोकं जयति ॥ .....अहीनाहादवस्थः ॥ सावित्रं विदां-  
चकार ॥ १० ॥ स ह हंसो.....भूत्वा ॥ स्वर्गं लोकमियाय ॥ .....देवभागो ह श्रौतर्षः ॥ सावित्रं  
विदांचकार ॥ ११ ॥ .....शूषो ह वाष्णोयः आदित्येन समाजगाम ॥

तै. ब्रा. ३. १०. ६.

“The Vaideha Janaka went with ‘days and nights’. They told that he who knows them becomes sinless and ascends to heaven. Ahina, the son of Aśvattha learnt the science of Sāvitra, He became a swan and ascended heaven. Śrautarṣa Devabhāga learnt the science of Sāvitra. The Vārṣṇeya Śūṣa became united with Āditya.”

This appears to be partly related to Vedānta philosophy ; but the context shows that it has also some bearing on astronomy. On the whole we are led to conclude that astronomy had grown into an independent science in the Vedic period.

In the above discussion all the Vedic quotations have been considered together. That does not mean, however, that they were all composed and

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SECTION II  
THE VEDĀNGA PERIOD  
CHAPTER I—VEDĀNGAS  
1. ASTRONOMY

“Śikṣā, Kalpa, Vyākaraṇa, Nirukta, Jyotiṣa and Chandas” are regarded as the six parts (Āṅgas) of the Vedas. At present a separate Sūtra (Kalpa) for each Veda is available and it is recited generally by the Vaidic Brahmins belonging to each branch (Śākhā); as regards other parts, the Vedas cannot possibly have separate ones. The remaining five parts, which are at present available, are recited by Rigvedi Brahmins only and not by those belonging to other Vedas. The Vedāṅga Jyotiṣa (astronomy) which we hear was recited by Vaidic Brahmins, consists of 36 verses ; but there is another work known as Vedāṅga Jyotiṣa and which is commented upon by Somākara. The commentary by Somākara gives the remark “Yajurvedāṅga Jyotiṣa by Śeṣa” at its end. This portion is not at all different from the one recited by the Rigvedi Brahmins. There is also another work known as Atharva Jyotiṣa. It cannot be said for certain that the three Vedas had originally different “astronomical works” (Vedāṅga Jyotiṣa) ; it will, therefore, be convenient to call them by different names for a clear understanding of the same. Let us call the astronomical work recited by Rigvedi Brahmins as “Rigveda Jyotiṣa” and that which bears the commentary by Somākara as “Yajurveda Jyotiṣa”. The Atharva Jyotiṣa is quite a different one. The first two are similar in many respects ; out of 36 verses belonging to Rg-Jyotiṣa, 30 are found in the Yajurveda Jyotiṣa also, which has 13 different verses. The total number of verses on astronomy and belonging to the two sections together amount to 49. It is also interesting to note, that of the 30 common verses, one verse is similar in meaning but different in words and metre.

No information regarding Somākara’s date, etc. is available and in no other work or commentary is his name found. His commentary is found to be of two kinds. One is an extensive commentary in which Somākara mentions his name in the beginning and adds at the end the remark “The Vedāṅga Jyotiṣa by Śeṣa ends.” The second kind is an abbreviation of the first one. It does not mention either Somākara’s name or the word “compiled by Śeṣa”, etc. Those verses which are very easy to understand or those which deal with mathematics, are left aside ; there is no harm if one thinks that Somākara did not understand the work at all. Even none of other astronomers appears to have attempted to explain the mathematical side of the Vedāṅga Jyotiṣa ; and because it has very little in common with other astronomical works, we seldom find its references in them, and those very few references will be dealt with in subsequent pages. This work is a very ancient one and as such occupies an important place in the history of astronomy. It should, therefore, be fully considered.

In 1879 A.D. Prof. Thibbaut published a small booklet on the translation of Yajurveda Jyotiṣa, which shows that he could succeed in explaining 6 verses more than what Somākara could do. In 1881 A.D. the author attempted to translate as many verses of Yajurveda Jyotiṣa as he could understand. Late Krishna Shastri Godbole had attempted to explain the work but

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जोत्रागः खेदेहीरोषाचिन्मूषण्यः सोमाधानः ॥ रेमुद्राश्वाओजःस्तृष्वोह्येष्ठाइत्युक्षा लिंगैः ॥ १४ ॥

This verse should be read as

जोत्रागः खेदेहीरोषाचिन्मूषण्यः सोमाधानः ॥ रेमुद्राश्वाओजः कृष्योह्येष्ठाइत्युक्षा लिंगैः ॥

which is the Yajurveda version and a correct one. In this verse 27 nakṣatras have been indicated by symbolic letters as follows :—

- |                                      |  |
|--------------------------------------|--|
| 1. Jau—Aśvayujau for Aśvinī          | 15. Dhā for Anurādhā                   |
| 2. Drā for Ārdrā                     | 16. Naḥ for Śravaṇaḥ                   |
| 3. Gaḥ—Bhagaḥ for P. Phalgunī        | 17. Re for Revatī                      |
| 4. Khe for Viśākhe                   | 18. Mṛ for Mṛgaśīrṣa                   |
| 5. Śve—Viśve (Deva) for U. Aṣādhā    | 19. Ghā for Maghā                      |
| 6. Hiḥ—Ahirbudhnya for U. Bhādrapadā | 20. Svā for Svātī                      |
| 7. Ro for Rohiṇī                     | 21. Paḥ—Āpaḥ for P. Aṣādhā             |
| 8. Śā for Āśreṣā                     | 22. Ajaḥ—Aja Eka Pād for P. Bhādrapadā |
| 9. Cit for Citrā                     | 23. Kṛ for Kṛttikā                     |
| 10. Mū for Mūla                      | 24. Śyaḥ for Puṣyaḥ                    |
| 11. Śak for Śatabhiṣak               | 25. Ha for Hasta                       |
| 12. Nyāḥ for Bharanyāḥ               | 26. Jye for Jyēṣṭhā                    |
| 13. Sū for Punarvasū                 | 27. Ṣṭhā for Śraviṣṭhā                 |
| 14. Mā—Aryamā for U. Phalgunī        |  |

The list contains the nakṣatras beginning with Aśvinī and then every 6th nakṣatra from it. The symbols are either the beginning letters or the ending letters of nakṣatra names or those of controlling deities.

The theory underlying this is as follows :— It appears from the above\* verse and from the 25 verses of Yajur Jyotiṣa that 1 yuga contains 124 parvas and hence one nakṣatra division is supposed to be divided into 124 parts. One yuga contains 1860 tithis and the Sun revolves through the nakṣatras 5 times during a mahāyuga (see Yajur Jyo. verses 28 and 31). Hence the Sun moves through  $\frac{5 \times 27 \times 124}{1860}$  i.e. 9 parts during one tithi. The following table gives the part (or degree) of a particular nakṣatra which the Sun occupies at the end of each Parva. From this it can be seen that the Sun will be found on the part number which is the ordinal number of nakṣatra in the list. For example : Aśvinī is the first and Ārdrā is the second nakṣatra; whenever the sun would come to Aśvinī (i.e. at the end of 5th, 30th, 55th, 79th and 104th parva) the sun would be found to occupy the first part or a multiple of 27 plus one part and when it would come to Ārdrā it would occupy the second part or multiple of 27 plus 2 parts and so on. In the last column of the table is noted the balance which remains after dividing the number of parts of a nakṣatra by 27. Each nakṣatra occupies that place in the list which is indicated by that number. The scheme or the system cited above can not be rightly understood, as the meanings of all the verses are not clear. It is just possible that originally there might have been verses explaining the system, but those verses are now lost for us.

\*A nakṣatra is supposed to consist of 610 Kalās (minutes), as given in verses 18 and 21 of Rk-version. This number refers to the Moon's motion.

The Sun's position at the end of each Parva in the 5 years of a Yuga.

| Month            | Serial<br>No.<br>of<br>Parva | Elapsed<br>Nakṣatra | Current Nakṣatra |                 |    | Remainder<br>(27 parts) |
|------------------|------------------------------|---------------------|------------------|-----------------|----|-------------------------|
|                  |                              |                     | Part             | Name            |    |                         |
| SAMVATSARA       |                              |                     |                  |                 |    |                         |
| Māgha . . .      | 1                            | 1                   | 11               | Śatabhiṣak . .  | 11 |                         |
| Māgha . . .      | 2                            | 2                   | 22               | P. Bhādrapadā . | 22 |                         |
| Phālguna . . .   | 3                            | 3                   | 33               | U. Bhādrapadā . | 6  |                         |
| Phālguna . . .   | 4                            | 4                   | 44               | Revatī . .      | 17 |                         |
| Caitra . . .     | 5                            | 5                   | 55               | Aśvayuj . .     | 1  |                         |
| Caitra . . .     | 6                            | 6                   | 66               | Bharanī . .     | 12 |                         |
| Vaiśākha . . .   | 7                            | 7                   | 77               | Kṛttikā . .     | 23 |                         |
| Vaiśākha . . .   | 8                            | 8                   | 88               | Rohiṇī . .      | 7  |                         |
| Jyeṣṭha . . .    | 9                            | 9                   | 99               | Mṛga . .        | 18 |                         |
| Jyeṣṭha . . .    | 10                           | 10                  | 110              | Ārdrā . .       | 2  |                         |
| Āṣāḍha . . .     | 11                           | 11                  | 121              | Punarvasū . .   | 13 |                         |
| Āṣāḍha . . .     | 12                           | 13                  | 8                | Āśreṣā . .      | 8  |                         |
| Śrāvaṇa . . .    | 13                           | 14                  | 19               | Maghā . .       | 19 |                         |
| Śrāvaṇa . . .    | 14                           | 15                  | 30               | P. Phalgunī . . | 3  |                         |
| Bhādrapada . . . | 15                           | 16                  | 41               | U. Phalgunī . . | 14 |                         |
| Bhādrapada . . . | 16                           | 17                  | 52               | Hasta . .       | 25 |                         |
| Āśvina . . .     | 17                           | 18                  | 63               | Citrā . .       | 9  |                         |
| Āśvina . . .     | 18                           | 19                  | 74               | Śvatī . .       | 20 |                         |
| Kārtika . . .    | 19                           | 20                  | 85               | Viśākhā . .     | 4  |                         |
| Kārtika . . .    | 20                           | 21                  | 96               | Anurādhā . .    | 15 |                         |
| Mārgaśīrṣa . . . | 21                           | 22                  | 107              | Jyeṣṭhā . .     | 26 |                         |
| Mārgaśīrṣa . . . | 22                           | 23                  | 118              | Mūla . .        | 10 |                         |
| Pauṣa . . .      | 23                           | 25                  | 5                | U. Āṣāḍha . .   | 5  |                         |
| Pauṣa . . .      | 24                           | 26                  | 16               | Śravaṇa . .     | 16 |                         |

## PARIVATSARA

|                |    |    |    |                 |  |    |
|----------------|----|----|----|-----------------|--|----|
| Māgha . . .    | 25 | 27 | 27 | Śraviṣṭhā . .   |  | 27 |
| Māgha . . .    | 26 | 1  | 38 | Śatabhiṣak . .  |  | 11 |
| Phālguna . . . | 27 | 2  | 49 | P. Bhādrapadā . |  | 22 |

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| Month                     | Serial<br>No.<br>of<br>Parva | Elapsed<br>Nakṣatra | Current Nakṣatra |                   | Remainder<br>(27 parts) |
|---------------------------|------------------------------|---------------------|------------------|-------------------|-------------------------|
|                           |                              |                     | Part             | Name              |                         |
| ANUVATSARA— <i>contd.</i> |                              |                     |                  |                   |                         |
| Āṣāḍha . . .              | 86                           | 12                  | 78               | Puṣya . . .       | 24                      |
| Śrāvaṇa . . .             | 87                           | 13                  | 89               | Āśreṣā . . .      | 8                       |
| Śrāvaṇa . . .             | 88                           | 14                  | 100              | Maghā . . .       | 19                      |
| Bhādrapada . . .          | 89                           | 15                  | 111              | P. Phalgunī . . . | 3                       |
| Bhādrapada . . .          | 90                           | 16                  | 122              | U. Phalgunī . . . | 14                      |
| Āśvina . . .              | 91                           | 18                  | 9                | Citrā . . .       | 9                       |
| Āśvina . . .              | 92                           | 19                  | 20               | Svātī . . .       | 20                      |
| Kārtika . . .             | 93                           | 20                  | 31               | Viśākhā . . .     | 4                       |
| Kārtika . . .             | 94                           | 21                  | 42               | Anurādhā . . .    | 15                      |
| Mārgaśīrṣa . . .          | 95                           | 22                  | 53               | Jyesthā . . .     | 26                      |
| Mārgaśīrṣa . . .          | 96                           | 23                  | 64               | Mūla . . .        | 10                      |
| Pauṣa . . .               | 97                           | 24                  | 75               | P. Āṣāḍhā . . .   | 21                      |
| Pauṣa . . .               | 98                           | 25                  | 86               | U. Āṣāḍhā . . .   | 5                       |

## IDVATSARA

|                  |     |    |     |                     |    |
|------------------|-----|----|-----|---------------------|----|
| Māgha . . .      | 99  | 26 | 97  | Śrāvaṇa . . .       | 16 |
| Māgha . . .      | 100 | 0  | 108 | Śrāviṣṭhā . . .     | 27 |
| Phālguna . . .   | 101 | 1  | 119 | Śatabhiṣak . . .    | 11 |
| Phālguna . . .   | 102 | 3  | 6   | U. Bhādrapadā . . . | 6  |
| Caitra . . .     | 103 | 4  | 17  | Revatī . . .        | 17 |
| Caitra . . .     | 104 | 5  | 28  | Āśvayuj . . .       | 1  |
| Vaiśākha . . .   | 105 | 6  | 39  | Bharaṇī . . .       | 12 |
| Vaiśākha . . .   | 106 | 7  | 50  | Kṛttikā . . .       | 23 |
| Jyestha . . .    | 107 | 8  | 61  | Rohiṇī . . .        | 7  |
| Jyestha . . .    | 108 | 9  | 72  | Mṛga . . .          | 18 |
| Āṣāḍha . . .     | 109 | 10 | 83  | Ārdrā . . .         | 2  |
| Āṣāḍha . . .     | 110 | 11 | 94  | Punarvasū . . .     | 13 |
| Śrāvaṇa . . .    | 111 | 12 | 105 | Puṣya . . .         | 24 |
| Śrāvaṇa . . .    | 112 | 13 | 116 | Āśreṣā . . .        | 8  |
| Bhādrapada . . . | 113 | 15 | 3   | P. Phalgunī . . .   | 3  |
| Bhādrapada . . . | 114 | 16 | 14  | U. Phalgunī . . .   | 14 |

| Month                  | Serial<br>No.<br>of<br>Parva | Elapsed<br>Nakṣatra | Current Nakṣatra |                     |    | Remainder<br>(27 parts) |
|------------------------|------------------------------|---------------------|------------------|---------------------|----|-------------------------|
|                        |                              |                     | Part             | Name                |    |                         |
| IDVATSARA—contd.       |                              |                     |                  |                     |    |                         |
| Āśvina . . . . .       | 115                          | 17                  | 25               | Hasta . . . . .     | 25 |                         |
| Āśvina . . . . .       | 116                          | 18                  | 36               | Citrā . . . . .     | 9  |                         |
| Kārtika . . . . .      | 117                          | 19                  | 47               | Svātī . . . . .     | 20 |                         |
| Kārtika . . . . .      | 118                          | 20                  | 58               | Viśākha . . . . .   | 4  |                         |
| Mārgaśīrṣa . . . . .   | 119                          | 21                  | 69               | Anurādhā . . . . .  | 15 |                         |
| Mārgaśīrṣa . . . . .   | 120                          | 22                  | 80               | Jyeṣṭhā . . . . .   | 26 |                         |
| Pauṣa . . . . .        | 121                          | 23                  | 91               | Mūla . . . . .      | 10 |                         |
| Pauṣa . . . . .        | 122                          | 24                  | 102              | P. Aṣāḍhā . . . . . | 21 |                         |
| Adhika Māgha . . . . . | 123                          | 25                  | 113              | U. Aṣāḍhā . . . . . | 5  |                         |
| Adhika Māgha . . . . . | 124                          | 26                  | 124              | Śravaṇa . . . . .   | 16 |                         |

कला दश च विंश स्याद् द्विमुहूर्तस्तु नाडिके ॥

द्वित्रिंशस्तत्कलानां तु षट्शतीव्यधिकं भवेत् ॥ १६ ॥

यजुःपाठ—

कला दश सविंशः..... ॥ द्युत्रिंशत् तत्..... ॥

“10 $\frac{1}{2}$  kalās make one ‘nāḍikā’, two nāḍikās are equal to one ‘muhūrta’ and 30 muhūrtas or 603 kalās make one day”.

नाडिके द्वेमुहूर्तस्तु पंचाशत्पलमाढकं ॥ माषकात्कुम्भको द्रोणः कुटर्पर्वधते त्रिभिः ॥ १७ ॥

The verse does not mention any relation between “Ādhaka” and “Droṇa”. Similarly the 24th verse of Yajur-Jyotiṣa, which gives different wording, does not give any relation. Varāhamihira, in the Varṣaṇādhyaṣya, says

पंचाशत्पलमाढकमनेन मिनुर्याज्जलं पतितं ॥ २ ॥

बृ० सं० २३.

It seems, while writing out this chapter, he must have had before his mind this very verse from Vedāṅga Jyotiṣa. But although he has made use of the term ‘droṇa’ in the next verse, he does not mention any relation between ‘ādhaka’ and ‘droṇa’. It may be, he did not find any suitable place wherein to mention this relation, because the four ‘quarters’ of the verse were already composed. Also, the commentator Bhaṭṭotpala says, “because 50 palas are said to make one ādhaka, and four ādhakas make one droṇa”. These parts of a verse so much agree with the 2nd and 3rd quarters of 17th verse of Vedāṅga Jyotiṣa, that Bhaṭṭotpala appears to have taken the quotation, without doubt, from Vedāṅga Jyotiṣa. Bhāskarācārya and the others have also mentioned ‘droṇa’ as equivalent to 4 ‘ādhakas’ and the real verse of Vedāṅga Jyotiṣa ought to run as follows and it will then remain in agreement with the context :—

नाडिके द्वे मुहूर्तस्तु पंचाशत्पलमाढकं ॥ चतुर्भिराढकैर्द्रोणः कुटर्पर्वधते त्रिभिः ॥ १७ ॥

“One muhūrta=two nāḍikās ; 50 palas=1 ādhaka ; 4 ādhakas =1 droṇa —this being larger than one nāḍikā by 3 kuḍavas”.

Here we have to take for granted the words “Than one nāḍikā”. This word occurs in the first quarter and we can take it without much difficulty. The sense which we thus get tallies with the clear meaning of the verse given by the Yajur-Jyotiṣa, which runs thus:

पलानि पञ्चाशदपां धृतानि तदाढकं द्रोणमतः प्रमेयं ॥

त्रिभिर्विहीनं कुडवेस्तु कार्यं तन्नाडिकायास्तु भवेत्प्रमाणं ॥ २४ ॥

“The vessel known as ‘āḍhaka’ holds 50 palas of water. Measure one droṇa of water with it. Throw away from it water equal to 3 kuḍavas in volume. Then the time needed for the remaining water (to trickle away) is known as one nāḍikā”.

The measure of the unit Kuṭapa (Kuḍava) which occurs in the verse needs understanding. Similarly another unit ‘Prastha’ denoting some measure of time has occurred before in verse No. 7. Vedāṅga Jyotiṣa does not give any relation between Prastha and Nāḍikā. Let us try to understand it. Bhāskarācārya says,

द्रोणस्तु खार्याः खलु षोडशांशः स्यादाढको द्रोणचतुर्थभागः ॥

प्रस्थश्चतुर्थांश इहाढकस्य प्रस्थाधिराद्यैः कुडवः प्रदिष्टः ॥ ८ ॥

लीलावती .

Meaning :—4 kuḍavas=1 prastha

4 prasthas=1 āḍhaka

4 āḍhakas=1 droṇa

and according to Vedāṅga Jyotiṣa, 50 palas make one āḍhaka. Hence, the following units can be interrelated as

1 droṇa=200 palas=64 kuḍavas.      1 prastha=12½ palas.

1 āḍhaka=50 palas.      1 kuḍava= 3⅓ palas.

Also according to Vedāṅga Jyotiṣa, 1 nāḍikā=1 droṇa minus 3 kuḍavas. Hence, 1 nāḍikā=61 kuḍavas=(200—3×3⅓) palas=190⅝ palas and 1 prastha=12½ palas,

therefore,  $1 \text{ prastha} = \frac{12\frac{1}{2}}{190\frac{5}{8}} = \frac{4}{61} \text{ nāḍikās.}$

It has been said in the 7th verse above that the day-light increases by 1 prastha per day, and it has been now proved that 1 prastha=4/61 nāḍikās, and this agrees with the theory underlying the method of calculating ‘measure of day’ (Dinamāna) described in 22nd verse. This shows that we have correctly established the relation between prastha, nāḍikā and other units. It has been proved that ‘nāḍikā’ stands for that measure of time during which 190⅝ palas volume of water would trickle away ; but no rule is given as to how to regulate the size of the hole to ensure the correctness of time for a definite volume of water to flow out. It appears that it was considered unnecessary to dilate upon this as the ghaṭikā vessel had come into common use since a long time. According to Amarkośa, Lilāvati and other works, one pala=4 karṣa =4 tolās of water ; or 190⅝ palas×4=762½ tolās ; which amounts to a volume greater than 9 seers of water. The ghaṭikā-vessels which are found in use at present can hold 1½ seers of water at the most. The bigger the vessel in size the greater is the accuracy of time and hence big vessels are always desirable.



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तस्यार्द्धमर्कजः पक्षस्तस्मात्पंचदशं दिनं ।

शतं लवानां षड्विंशं (१२६) लवाः पंचदश ( $\frac{1}{15}$ ) स्तथा ॥ ७ ॥

\* त्रिंशच्चाष्टादशशतं (१८३०) युगमार्कैर्दिनैः स्मृतम् ।

वृद्धिक्षयाभ्यां संभूतं चान्द्रं मानं हि चन्द्रतः ॥ ८ ॥

लवं लवमथोनेन सावनेन निशाकरः ।

क्षयवृद्धिमवाप्नोति स चान्द्रो मास उच्यते ॥ ९ ॥

तस्यार्द्धं पार्वणः पक्षस्तस्मात्पंचदशी तिथिः ।

प्रमाणेन लवानां तु द्वाविंशं शत (१२२) मूच्यते ॥ १० ॥

सोमस्याष्टादशशती युगे षष्ठ्याधिका (१८६०) स्मृता ।

यावतात्वेव कालेन भवर्गं त्रिणवात्मकम् ॥ ११ ॥

भुङ्क्ते चन्द्रः स आक्षो मासस्तस्यार्द्धं पक्ष उच्यते ।

आक्षति पक्षात् पंचदशं नाक्षत्रं दिनमुच्यते ॥ १२ ॥

प्रमाणेन लवानां तु द्वादशं शत (१२२) मुच्यते ।

षष्ठ्या तु सप्तषष्ठ्यंशे ( $\frac{60}{67}$ ) नाधिकोऽस्मिन् परोलवः ॥ १३ ॥

दशोत्तरैर्द्विसहस्रै (२०१०) युगमार्कैर्दिनैः स्मृतम् ।

## STUDY OF RG-YAJUR-VEDĀNGA-JYOTIṢA

### The Composition period

Let us now consider the problem of the "time of Vedāṅga Jyotiṣa". It has been told in the 6th verse of Rg-Jyotiṣa that the winter solstice commences from the beginning of Śraviṣṭhā and the summer solstice from the middle of Āśreṣā. At present the sun turns towards north when the sun and the moon conjoin near the Purvāṣāḍhā constellation. The solstitial point is thus seen to be gradually receding. This phenomenon is termed "*Ayana Calana*". The equinoctial motion is very accurately known in our time and with its help can be found the time when the luni-solar phenomena described in Vedāṅga Jyotiṣa had occurred.

European scholars like Colebrooke have found out the time of Vedāṅga Jyotiṣa, basing their calculations on the assumption that in those times the sun and the moon conjoined on the winter solstice day with the beginning point of the Dhaniṣṭhā division, the zodiacal divisions being supposed to begin from the Revatī star. It amounts to supposing the Alpha-Delphini star as the beginning point of Dhaniṣṭhā division, which is not the case, the fact being that the star Alpha is in advance of the beginning point by 4° 11'; and hence, the time calculated by them is mistaken by an amount of time (*viz.* 300 years) which is necessary for the equinoctial point to recede by 4° 11'. What does the statement "winter solstice began at the beginning of Dhaniṣṭhās" mean? How can we say that the winter solstice commenced when the sun and the moon come near that imaginary point which is the beginning of an imaginary Dhaniṣṭhā division? And it is a fact that the beginning point of the Dhaniṣṭhā division (which is one of the nakṣatra divisions belonging to Āśvinyādi system) is an imaginary point.

\* There is some misprint in the reading. It ought to give 1800 as the meaning.



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तेऽर्चिरभिसंभवंत्यर्चिषाहेरह्म आपूर्यमाणपक्षमापूर्यमाणपक्षातेदुग्गयनमुदगयनाद्देवलोकं देवलोकान्-  
विभ्यमादित्याद्वैद्युतं वैद्युतान्मानसं मानसः पुरुषो भूत्वा ब्रह्मलोकमभिसंभवति ते न पुनरावर्तते  
शिष्टा वंदशूका यत इदं न जानन्ति तस्मादिदं वेदितव्यमथाप्याह ॥ ८ ॥

अध्याय १४.

आकाशगुणः शब्द आकाशाद्वैद्युत्विगुणः स्पशेन वायोऽर्ज्योतिस्त्रिगुणं रूपेण ज्योतिष अश्चतुर्गुणं ।  
रसेनाद्भ्यः पृथिवी पञ्चगुणा गन्धेन पृथिव्या भूतप्राप्त्यावरजंगमास्तदेतदहर्गुणसहस्रं जागर्ति  
तस्यांते सूक्ष्मस्यङ्गानि प्रत्याहरति भूतप्राप्ताः पृथिवीमपि यन्ति पृथिव्यं आपो ज्योतिषं  
ज्योतिर्वायुं वायुराकाशमाकाशो मनो मनो विद्यां विद्या महान्मात्मानं महानात्मा प्रतिभां  
प्रतिभा प्रकृतिं सा स्वप्तिं युगसहस्रं रात्रिस्तावेतावहोरात्रावजस्रं परिवर्तते स कालस्तदेतदहर्भव  
युगसहस्रपर्यन्तमहर्बद् ब्रह्मणो विद् रात्रिं युगसहस्रांतां तेहोरात्रविदो जना इति ॥ ४ ॥

अध्याय १४.

#### Yuga and Other Units of Time

The description about these time units is mostly similar to that found in Manusmṛiti and astronomical works. The Nirukta defines Brahmā's one day as the period of 1000 yugas, no clue being given as to the measure of a yuga in years; during this time the creation, maintenance and destruction of the Universe take place. Brahmā's night also is of the same length (i.e. 1000 yugas) during which time he sleeps; the period of 'a day plus a night' is called Brahmā's "ahorātra". These repeat continuously infinite number of times. The period of Brahmā's 'ahorātra' is identical with the one known as 'Kalpa' to the Sūrya Siddhānta and other astronomical works. The word 'Kalpa' does not occur in it. It is needless to say that Nirukta is the most ancient of all works which describe the long period of Yuga and other units. Although nothing is said about the measure of a yuga in terms of solar years, it is certain that it was definitely not so small a measure as five years. However the statements on the whole suggest some larger length for this term.

#### 4. PĀṆINĪ'S GRAMMAR

One comes across words like 'Varṣa' (5-1-88, 7-3-16) and 'Hāyana' (4-1-27; 5-1-130), occasionally found in the Vedas. One can read about lunar months denoted by Caitra etc. (4-1-21) and the term 'Muhūrta' (indicating a part of a day) (3-3-9). Similarly the term 'Nāḍi' denoting a number one or more than one (and not denoting a sinew in the body) occurs in it (5-4-159). This shows that the term 'Nāḍi' was used to indicate some measure of time. The term 'tithi' is not found in Pāṇinī; but one should not say from this that the term was unknown to people in Pāṇinī's time. This grammatical work does not deal with astronomical subjects or religious topics such as the commands to do or not to do certain acts on certain nakṣatras. Hence, we can not say that the astronomical terms which do not occur in this work were unknown in his time. Also, of the names of yuga's (Kṛta etc.), the term Kali does occur in Pāṇinī, but not in the sense of a yuga; this is not sufficient to prove that the Kṛta and other units of yuga were unknown in Pāṇinī's time.



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a half-month according to Vedāṅga Jyotiṣa comes to be 14d. 45gh.  $29\frac{1}{31}$  p. and that according to S. S. and European astronomical works it comes to 14d. 45gh.  $55\frac{3}{50}$  p. The 13-day half-month is possible when its mean value would be less than 14 days. This is never possible if mean values are taken for the motions of the sun and the moon ; but it is possible if true positions are reckoned. For example, the dark half of Phālguna, Śaka 1793 and the light half of Jyaiṣṭha, Śaka 1800 were 13-day half-months. On both these occasions the Grahalāghava almanac and the Keropant's almanac (which took figures from English Nautical Almanac) gave a half-month a measure which was less than 14 days by a few ghaṭis. The occasions when the half-month's measure would be less than 14 days are very few and it is not necessary that a 13-day half-month would emerge on all these occasions. For example, suppose that on the first day of a month (Meṣa) or on the 1st date of an English Calendar month the new moon or full moon takes place at 4 ghaṭis after sunrise and suppose that by reckoning the true motion, the actual measure of half-month came to be 13 days 55 gh.; then the next lunation will take place (*i.e.* the full moon or the new moon would take place) at the end of 59th ghaṭi on the 14th day. Now, because first Parva-end occurred on the 1st day of the solar or civil month, after sunrise, that civil day would be included in the previous half-month and hence, only 13 days would be left to be reckoned in the next half-month. Taking the same example, if we suppose that the first lunation occurred after 10 ghaṭis after sunrise on the 1st date, the second lunation will occur on the 15th day at 5 ghaṭis after sunrise ; hence, the half-month will consist of 14 civil days and not 13. It is therefore quite clear that a 13-day half-month is never possible if mean motions are adopted and the fact that reference of such a half-month occurs in the above lines, leads one to infer that the Indians knew how to calculate true positions of planets even so early as in the Mahābhārata age; and this is a very important thing to note. Some one is likely to raise a doubt that the reference of a 13-day half-month in the Mahābhārata is an actual phenomenon recorded by actually counting the number of civil days elapsed between one lunation to the other after seeing the moon's position in the sky every night and not as a result of calculations based on mean or true motions of planets. This is simply an impossibility. A 13-day half-month is possible (as is shown above) only when the ending moments of new or full moons are about a few ghaṭis before or after sunrise. The moon is never visible on a new moon day, and it is doubtful if it is visible when the ending moments occur near about sunrise. A calm consideration of the problem will convince one that the possibility of such a missing half-month is noticeable not by observation of moon's position by actual mathematical calculation. It is difficult to explain the thing more clearly and in shorter terms.

The above references show that the lunar eclipse had fallen on the Kārtiki full moon day and solar eclipse on the next following new moon day. Now, when a 13-day half-month is the light half of a month, the beginning eclipse must be solar and the ending one a lunar as can be seen from such a half-month *viz.* Vaiśākha Śukla pakṣa of current year (*i.e.* Śaka 1817). But, if a 13-day half-month is to be taken as a dark half of a month, the falling of a lunar eclipse in the beginning and that of a solar eclipse at the end is an impossibility. One will not find such an example in any of the past almanacs. Even if it be supposed that such a half-month did occur, maximum length of it would be 13 days 30 ghaṭis ; but the max-length of actual 'any 13 consecutive civil days' can never be less than 13 days 50 ghaṭis. According to modern accurate

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Pāṇḍavas' time has not been found beyond doubt as yet on the basis of planetary positions given by the Mahābhārata ; but this does not mean that these positions were incorrect. The author believes that the references found in the dialogue between Karna and Vyāsa indicate factual position of the planets and that they have been incorporated in the Mahābhārata on the basis of the information handed down direct from Pāṇḍavas' time. It can at most be said that we are unable to establish the agreement. He has seen how one gentleman, Janardan Hari Athalye, has attempted to disprove Mr. Lele's theory and to establish the agreement with the help of nirayana system of astrology. He does not think that Lele has succeeded in his attempt even to some extent. He does not know who will be able to explain the validity of the references of planetary positions.

The names of months, Caitra etc., were in vogue in Pāṇḍavas' time and they could not have belonged to a period earlier than 4000 B.S. (i.e. before Śaka\*) ; (this will be proved later on). This shows that Pāṇḍavas' time can not be taken to be earlier than 4000 B.S.

By the by, the author notes down the Pāṇḍavas' time as can be established from historical references found in the *Viṣṇu Purāṇa* and the *Śrīmadbhāgavata* :—

महान्विसृतः शूद्रागर्भोद्भूतोऽतिलब्धो महापद्मो नंदः परशुराम इवापरोऽखिलक्षत्रि-  
यांतकारी भविता ॥ ४ ॥ तस्याप्यष्टौ सुताः सुमाल्याद्या भवितारस्तस्य च  
महापद्मस्यानु पृथ्वी भोक्ष्यति । महापद्मस्तु पुत्राश्च एकं वर्षशतमवनीपतयो  
भविष्यति । नंदतान्द्वान् कौटिल्यो ब्राह्मणः समुद्धरिष्यति ॥ ६ ॥  
तेषामभावे मौढ्याश्च पृथ्वी भोक्ष्यति । कौटिल्य एव चंद्रगुप्तं राज्येभिषेक्षति  
॥ ७ ॥

यावत्परीक्षितो जन्म यावन्नन्दाभिषेचनं । एतद्वर्षसहस्रं तु ज्ञेयं पंचदशोत्तरं ॥३२॥

विष्णुपुराण, अंश ४ अध्या. २४.

These verses describe in a 'future form' the number of years of reign by kings of different dynasties, e.g. 1015 years elapsed between the king Parīkṣit (grand son of Yudhiṣṭhira) and the crowning of Nanda. After him 9 Nandas ruled for 100 years, and after them the Emperor Candragupta Maurya (the disciple of Cāṇakya) came to throne. The same story is related in chapters 1 and 2 of 12th section of the Bhāgavata, with the difference that the word 'Śatam' is found substituted for 'Jñeyam' which means that from Parīkṣit to Nanda as many as 1115 years passed. When Alexander the Great came to India, Candragupta had gone to see him. He (Candragupta) came to throne at Patna in the year 316 B.C. At the time of Seleucus who was a very strong general of Alexander, Candragupta was known to be a very great king. His grandson was Aśoka and these were well known facts of history beyond controversy.

If the description given by the Viṣṇupurāṇa and the Bhāgavata about the years of reign (viz. 1015 or 1115 years) of kings from Parīkṣit to Nanda be correct, we will have to take for Pāṇḍavas' time a year near about 1431 or 1531 B.C. and almost all European scholars accept this time as correct.

\*The Śaka era differs from Christian era by only 78 years. The time established by astronomy as being some year before Śaka era is likely to err by 78 years on account of so many reasons. Hence a date given by the author as B.S. may, for practical purposes, be taken even as so many years B.C.

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verse will show that people had observed that the other side of the moon is never visible :—

यथा हिमवतः पार्श्वं पृष्ठं चंद्रमसो यथा ॥ न दृष्टपूर्वं मनुजैः

शांतिपर्व, अध्या. २०३ मोक्षधर्म.

These references show that we find among the people a curiosity of finding causes of natural phenomena after observing the miracles on the earth and in the sky.

### *The Samhitā Section*

In the Mahābhārata we come across many references about suggestions to do or not to do certain things as per Muhūrta section of Samhitā branch of astronomy . It has already been shown above that the planetary positions have been given in the Mahābhārata with a view to describing the probable effects of such positions.

यतो वायुर्यतः सूर्यो यतः शुक्रस्ततो जयः ॥ २० ॥ एवं संचित्य यो याति तिथिनक्षत्र-  
पूजितः ॥ २५ ॥ विजयं लभते नित्यं सेनां सम्यक् प्रयोजयन् ॥

शांतिपर्व, अ. १००.

This has been addressed to Dharma by Bhīṣma. The starting for expedition on Puṣya nakṣatra has been described at many places as being very auspicious. At one place we find mention of a 'Bhaga' nakṣatra as auspicious for marriage. In the Vedas alone we find 'Bhaga' as the deity controlling Uttara Phalgunī ; otherwise we find her as controlling Pūrva Phalgunī. But P. Phalgunī has not been included in the list of nakṣatras devoted to celebration of marriages. The following line refers to Draupadī's marriage with Dharmarāja.

अद्य पौष्यं योगमुपैति चंद्रमाः पाणिं कृष्णायस्त्वं (धर्मराज) गृहाणाद्य पूर्वं ॥ ५ ॥

आदिपर्व, अ. १६८.

Because Puṣya is not regarded as a marriage-nakṣatra, Caturdhara, the commentator, defends the acceptance of this nakṣatra saying "By the word 'Pauṣya' is to be understood that nakṣatra which causes nourishment and not the Puṣya nakṣatra". The author does not agree with the explanation. The next description will show that Draupadī was married to five Pāṇḍavas on five consecutive days ; but in our present day list of marriage-nakṣatras we do not find any five nakṣatras which are consecutive in order.

### *Summary*

Matters of astronomical interest occurring in the Mahābhārata have been so far discussed, some of which are of much importance. Even though the terms, Meṣa, Vṛṣa, etc. and the names of week-days are not found in the Mahābhārata, it need not be suspected that these have been borrowed from the Greeks. The author reiterates them as follows :—(1) People had knowledge about planets at the time of Pāṇḍavas, whatever that time may be. No one thinks it was later than 1500 B.S. In any case, it was the time before names of 7 days and names of signs came into use, that is, before our astronomy came in contact with the Greek system. (2) The ecliptic was divided into 12 parts with respect to the sun's position. (3) The reference of a 13-day half-month shows that people had a working knowledge of finding the true positions of

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The order of names for the 7 week-days is as follows :

If the planets be regarded as revolving round the earth, they can be written in their order as Saturn, Jupiter, Mars, Sun, Venus, Mercury and Moon. It is assumed that the day is divided into 24 hours (Horā) and these horās are controlled by these seven planets in this very order. These planets get the lordship of the horās thrice in a day and 3 more horās remain. Hence, the lordship of the 1st horā at sunrise passes on to the 4th planet. If, for example, the lord of the first hour on the first day be Saturn (then last 3 hours will be controlled by Saturn, Jupiter & Mars) and Sun will be the lord of the first hour on the next day ; and following the convention that Lord of the first hour to be reckoned as the lord of the whole day, if Saturn be the Lord of the first day, the Sun becomes Lord of the second and hence, Saturday is followed by Sunday. Thus we get the usual order of names of week days. It should be noted that the next day bears the name of every 4th planet from the previous one. The Sūrya Siddhānta observes as follows about it :—

मंदादयः क्रमेण स्युश्चतुर्थी दिवसाधिपः ॥७८॥

होरेणाः सूर्यतनयोदधोयः क्रमशस्तथा ॥७९॥

भूगोलाध्याय.

“The Lords of days are to be reckoned in order fourth from Saturn downwards. The lords of hours also are to be reckoned commencing from Saturn downwards.”

Even Āryabhaṭa says that the lords of days are to be taken as ‘4th from the previous one’ “*Sighra Kramāt caturthāḥ dinapāḥ*” (Kal Kri. 16).

The system of dividing a day into 24 parts called ‘horā’ is true only in consideration with the theory of week days and astrology. The astronomical works, Siddhāntas, do enumerate time-units but they do not mention ‘horā’ as one of them, and no work belonging to Vedic and Vedāṅga period ever mentions it. This word is not Sanskrit in origin. Varāhamihira has attempted to justify its Sanskrit origin by explaining that the word is ‘coined’ by taking the middle portion of the word *Ahorātra*, leaving out ‘A’ and ‘Tra’, but this explanation is not satisfactory. The Chaldeans had this unit in use since a long time and they did have a week of seven days as at present. Considering this the author feels that ‘Week-days’ do not belong to us but have been borrowed from Chaldeans.

It has been shown under the topics of Vedāṅga Jyotiṣa and the Mahābhārata that the terms Meṣa and others are Sanskrit and it can not be said for certain that the system of dividing the ecliptic into 12 parts did not originally belong to us. Even from Vedic works we find that people did conceive the idea of giving to asterisms names similar to some well known shapes. We can not, therefore, say for certain that the Meṣādi signs are not ours. These terms, however, do not belong to Vedic or Vedāṅga Jyotiṣa period, which means that these were not in use before 1500 B.S. Now looking to the history of other nations, some say that these were known to Egyptians before 2160 B.C. and according to others even before 3285 B.C. Some are of opinion that Chaldeans knew both Vāra and Rāsis before 3800 B.C. In any case, it can be said for certain that both these nations knew the terms before 1000 B.C. and Mr. Laing writes emphatically that the ‘Vāras’ were known to Chaldeans long before 3800 B. C.\*

\* See Proctor Lockair’s English book “Nineteenth Century” and his article in the July 1892 issue, page 34 ; also see S. Laing’s Human Origins, Chap. V. pp. 144-158.

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known after studying the precessional motion of equinoxes. They in the Vedic age had the system of interpolating an intercalary month at the proper place so as to maintain the correct relation of lunar months with the seasons, so that the months of Madhu and Mādhava would on average be found to occur in the spring season. Even when a 'fixed year' came into vogue in the latter part of the Vedic age, the year was to commence with W. S. as ordained by Vedāṅga Jyotiṣa, and other works recommended the commencement of a year with spring. From this, it is clear that their object was throughout that of following a seasonal year and they never dreamt that they are not following a tropical year system just as we in the present time do not suspect the change. Even if Mr. Tilak's argument be accepted that in Vedic times year commenced from W. S., the commencement of a year with a solstice is nothing else than following a seasonal year, and the year proves to be tropical and not a sidereal (or fixed) one. In short, we find that the seasonal year was in long use before the fixed year and from historical point of view the tropical year was acceptable to 'Śrutis' and it was a natural one. Spring has been described as the 'mouth' of a year, Madhu and Mādhava as months of the spring season and the Madhvādi names were current. All these things can not remain true without following a tropical year. The seasons will not be found to occur in the same months by following the nakṣatra-month-system, and an idea of their departure from the usual position is already given on page 132. From this it is proved that it was the tropical year which was acceptable to Śrutis.

### THE YUGA SYSTEM

Almost all aspects of the Yuga-system have been discussed in the preface. According to Āryabhaṭa II, Mercury was behind the sun by about  $9^\circ$  in the beginning of the present Kaliyuga. According to the Sūrya-Siddhānta and Āryabhaṭa I the longitude of the moon's Apogee was  $90^\circ$  and that of its Node  $180^\circ$ ; but Brahmagupta and Āryabhaṭa II quote different values for them.

While examining the works of the Manu Smṛti and the Mahābhārata it has been shown that the measures of time units, yugas etc., as given by astronomical (Siddhānta) works, were already defined and fixed. These works are said to give as a criterion of the commencement of yuga the condition that all planets must come together in the beginning of Kaliyuga and of each other Yuga. (According to some other works all planets come to a close conjunction at the beginning of a Kalpa and come together within a reasonable proximity in that of a Mahāyuga). This criterion or condition is neither found in these works or in any of the works discussed before. On the contrary we find in the Mahābhārata the condition for starting a Kṛtayuga, to be "the coming together of the sun, Jupiter, the moon and the Tīṣya (Puṣya) star" (Vana Parva, 190.90/91). Similarly according to the astronomical works, the Kaliyugā started in the year 3179 B.S. But we do not find in any later works an explicit or implicit mention of this yuga having been so started. No reference to this age or to a criterion of the commencement is found in any of the Purāṇas and the above mentioned condition also is not well known.

The current year Śaka 1817 is the 4996th year of Kali elapsed. It shows that so many years have elapsed after the commencement of the Kali era. This era, according to the Sūrya Siddhānta, commenced on Thursday at midnight when it was the mean Amāvasyā of Phālguna. According to some other Siddhāntas it commenced after 15 ghaṭis more, that is on Friday morning. Prof. Whitney has, in his translation of the Sūrya-Siddhānta in English

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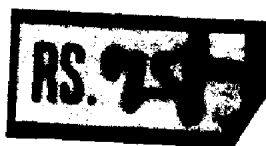
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It is evident that people had acquired knowledge of stars even before this, and this lends a support to our views expressed about the times of the Vedic period and that of compilation of the R̥k-Saṃhitā.

### KṚTTIKĀDI SYSTEM

कृत्तिकाः प्रथमं ॥ विशाखे उत्तमं ॥ तानि देवनक्षत्राणि ॥

अनुराधाः प्रथमं ॥ अपभरणीरुत्तमं ॥ तानि यमनक्षत्राणि ॥

यानि देवनक्षत्राणि ॥ तानि दक्षिणेन परियन्ति ॥

यानि यमनक्षत्राणि ॥ ७ ॥ तान्युत्तरेण ॥

तै. ब्रा. १. ५. २.

“Kṛttikās are the first and Viśākhā the last ; these constitute Divine nakṣatras : Anurādhā is the first and Apabharaṇī the last ; these constitute Yama nakṣatras : The divine stars turn from South (to North) and the Yama nakṣatras from North (to South)”.

The bracketted words are not given in the original text ; but Mādhavācārya, the commentator of the Vedas has rendered the word ‘dakṣiṇena’ as ‘from south to north’ in the following lines in the Taittirīya Saṃhitā (See Chapter on ‘ayana’ by Kāla Mādhava).

तस्मादादित्यः षण्मासो दक्षिणेनैति षडुत्तरेण ॥

तै. सं. ६. ५. ३.

“The sun goes by the south for six months and for six months by the north.”

The word ‘dakṣiṇena’ can mean “to the south of a certain object” ; but no mention of a second object has been made in the sentence. If the divine stars be taken to be situated to the south of the ecliptic and the others to its north, it is an impossibility ; because, Kṛttikās lie to the north of the ecliptic, the next 3 constellations are situated to its south, and the next 2 are again found to lie to the north ; the stars are thus irregularly situated and the latitudes of the stars will never change (they might vary only by a minute or two of an arc in thousands of years). Hence, the description can not be said to be with reference to the ecliptic. Similarly it can not happen that all ‘Kṛttikādi’ groups be found to be situated to the south of the equator and others to the north. The declination of stars always changes due to the precession of equinoxes, i.e. their position, north or south of the equator changes. But because the latitudes of some stars like Arcturus (Svātī), Altair (Śravaṇa), Delphini (Dhaniṣṭhā), Alpha-Andromeda. (Uttarabhādrapadā) are greater than 24°, these stars will never be found to lie to the south of the equator\*. Hence, none of 13 consecutive constellations will be found to lie to any one side of the equator. If an observer stands at any place on the earth, he will not find half the number of constellations moving from the northern side and half from the southern. Hence, the line ‘dakṣiṇena pariyanti’ can not be rendered as ‘to the south of any particular object’. If we translate the above lines as “the Kṛttikādi stars move from South to North”, the sum total of the argument becomes that these are found to be situated in the sun’s path when it moves from south to north. This leads one to

\* I have attempted to find the positions of stars in 2350 B.C., 1462 B.C., 570 A.D. and 1887 A.D., but I never found that 13 consecutive constellations were on the same side of the equator. The calculations can not be given for want of space.—Author.

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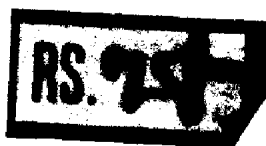
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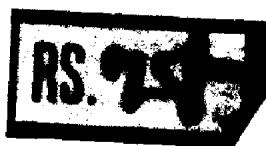
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